



US007561413B2

(12) **United States Patent**
Kyouzuka et al.

(10) **Patent No.:** **US 7,561,413 B2**
(45) **Date of Patent:** **Jul. 14, 2009**

(54) **ELECTRONIC APPARATUS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 367 days.

(21) Appl. No.: **11/144,486**

(22) Filed: **Jun. 3, 2005**

(65) **Prior Publication Data**

US 2006/0044263 A1 Mar. 2, 2006

(30) **Foreign Application Priority Data**

Aug. 27, 2004 (JP) 2004-249259

(51) **Int. Cl.**

H05K 7/00 (2006.01)

(52) **U.S. Cl.** **361/679.06**; 345/156; 248/921

(58) **Field of Classification Search** 361/683,
361/679.06; 345/156; 248/921

See application file for complete search history.

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Primary Examiner—Jayprakash N Gandhi

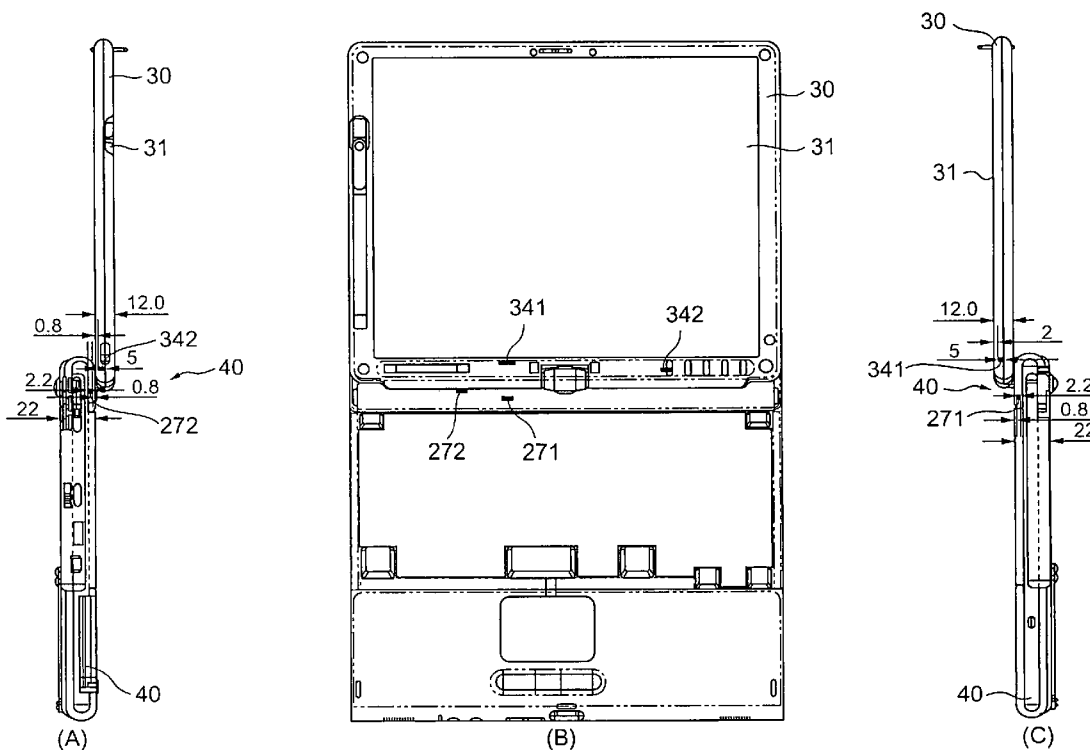
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(57) **ABSTRACT**

An electronic apparatus has a first unit having a keyboard and a second unit having a display screen. The second unit is coupled to the first unit through a two-axis coupling section to be opened, closed, and rotated relative to the first unit. A first sensor and a second sensor are disposed on the first unit whereas a first member and a second member are disposed on the second unit. The first member comes near and affects the first sensor in a first closed status in which the second unit is closed to lie on the first unit with the display screen facing the first unit. The second member comes near and affects the second sensor in a second closed status in which the second unit is closed to lie on the first unit with the back of the display screen facing the first unit.

5 Claims, 37 Drawing Sheets



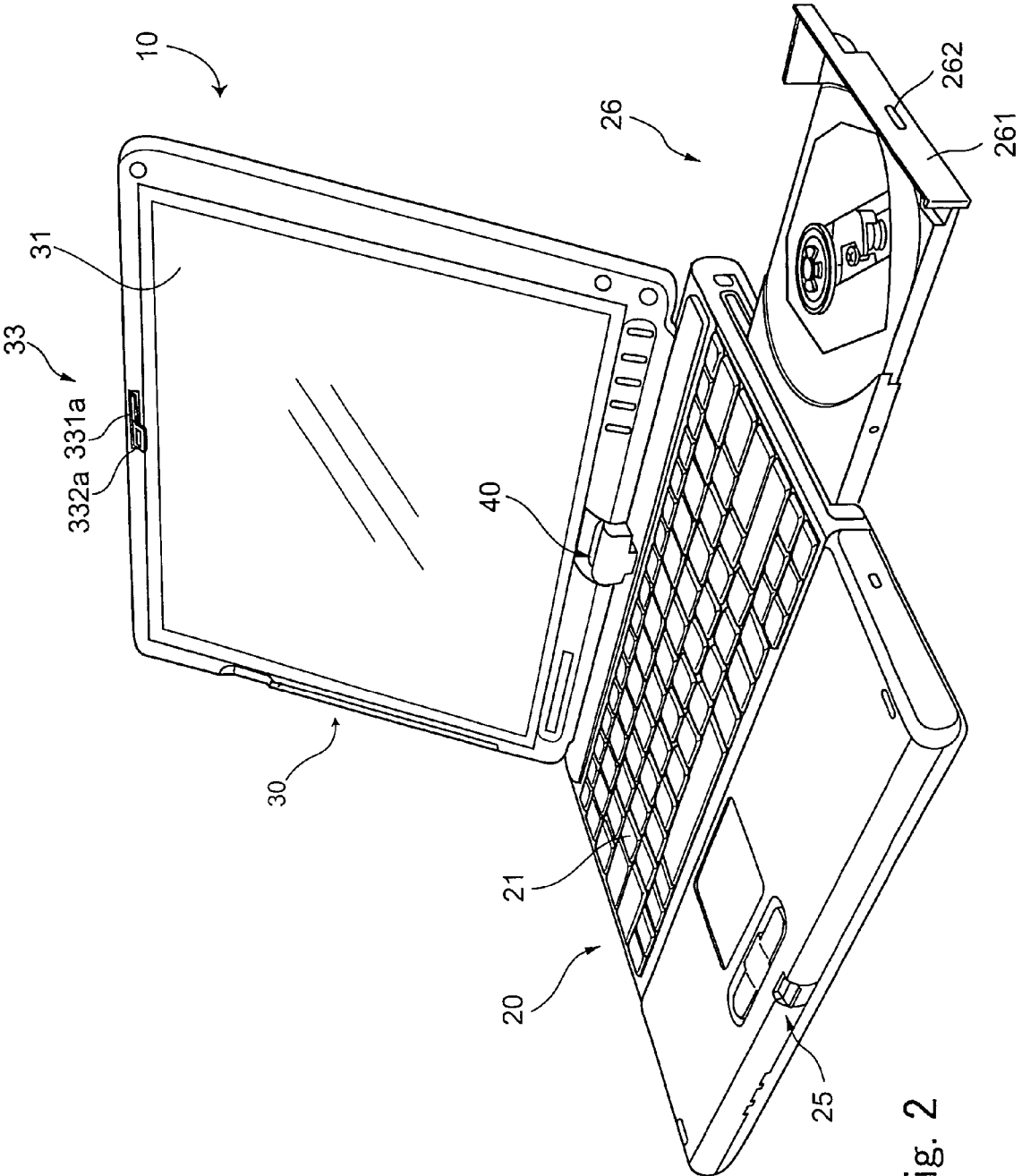


Fig. 2

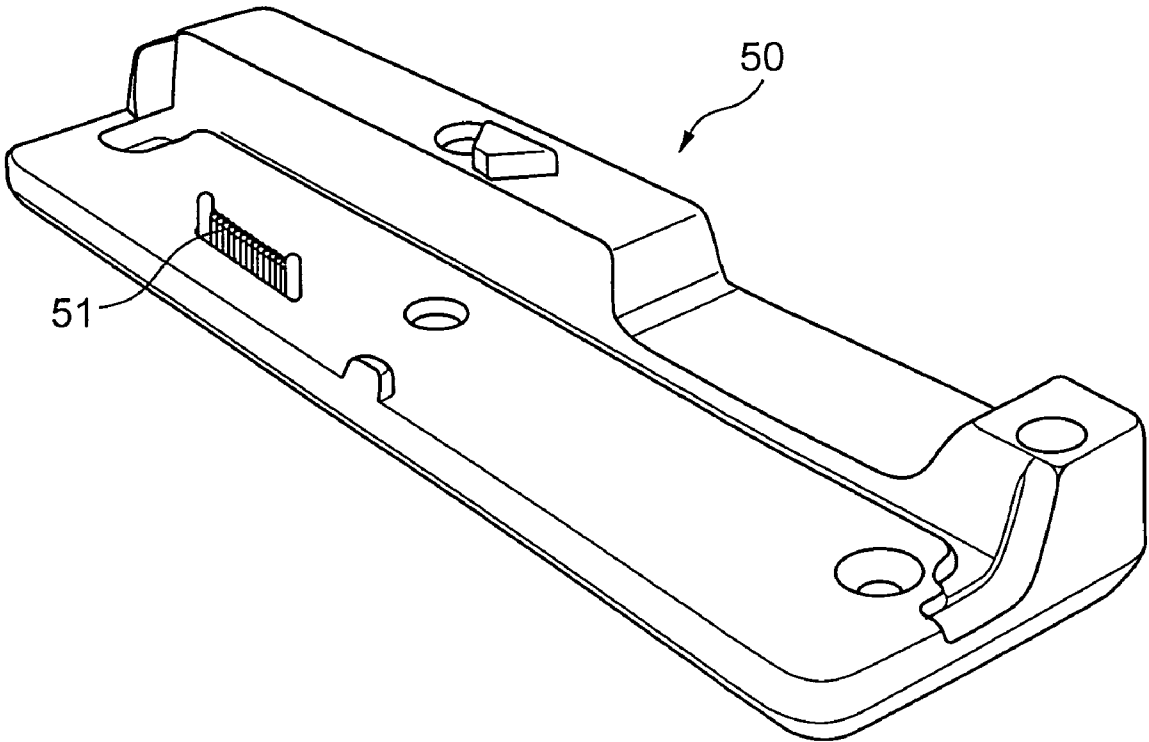


Fig. 3

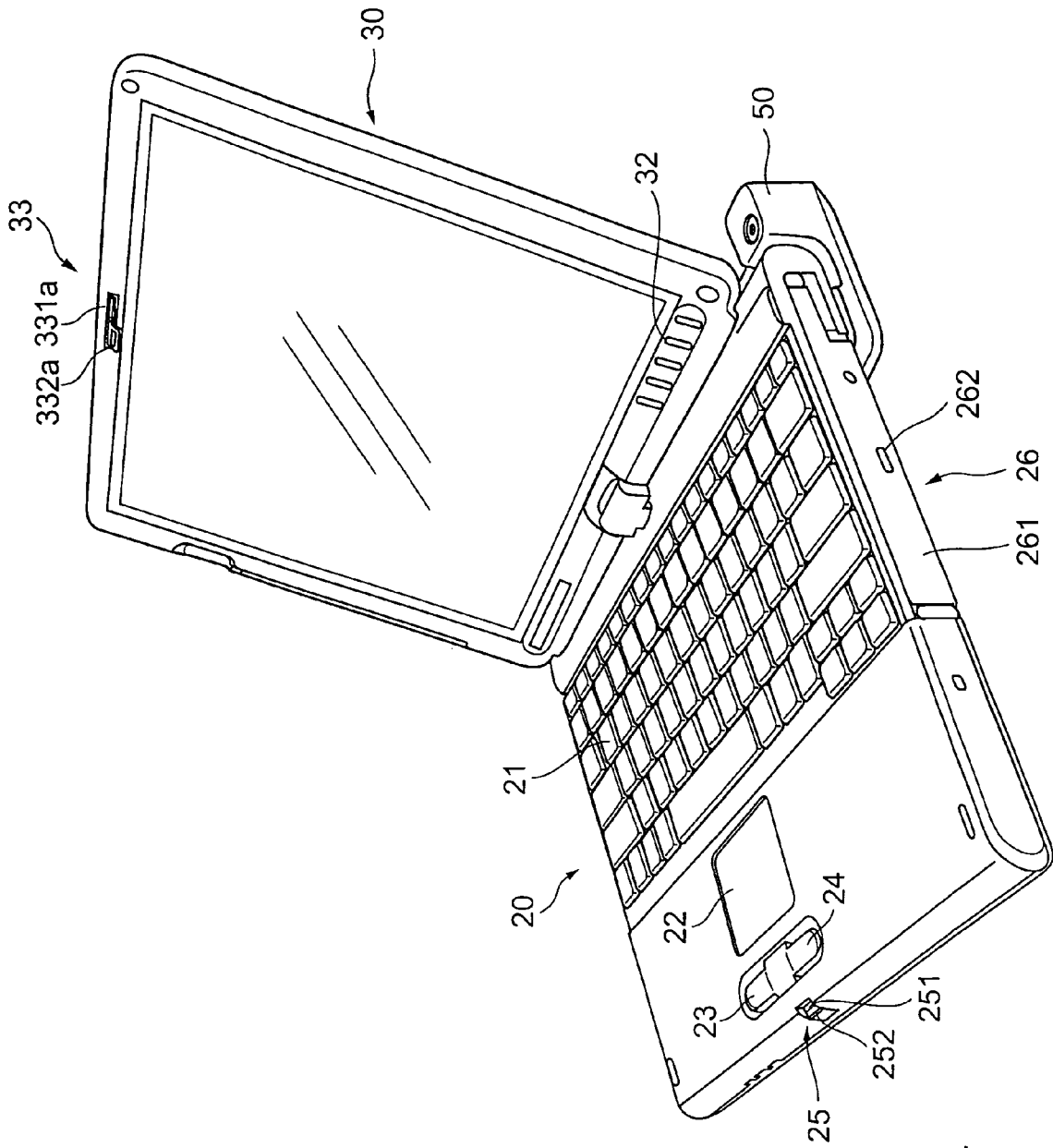


Fig. 4

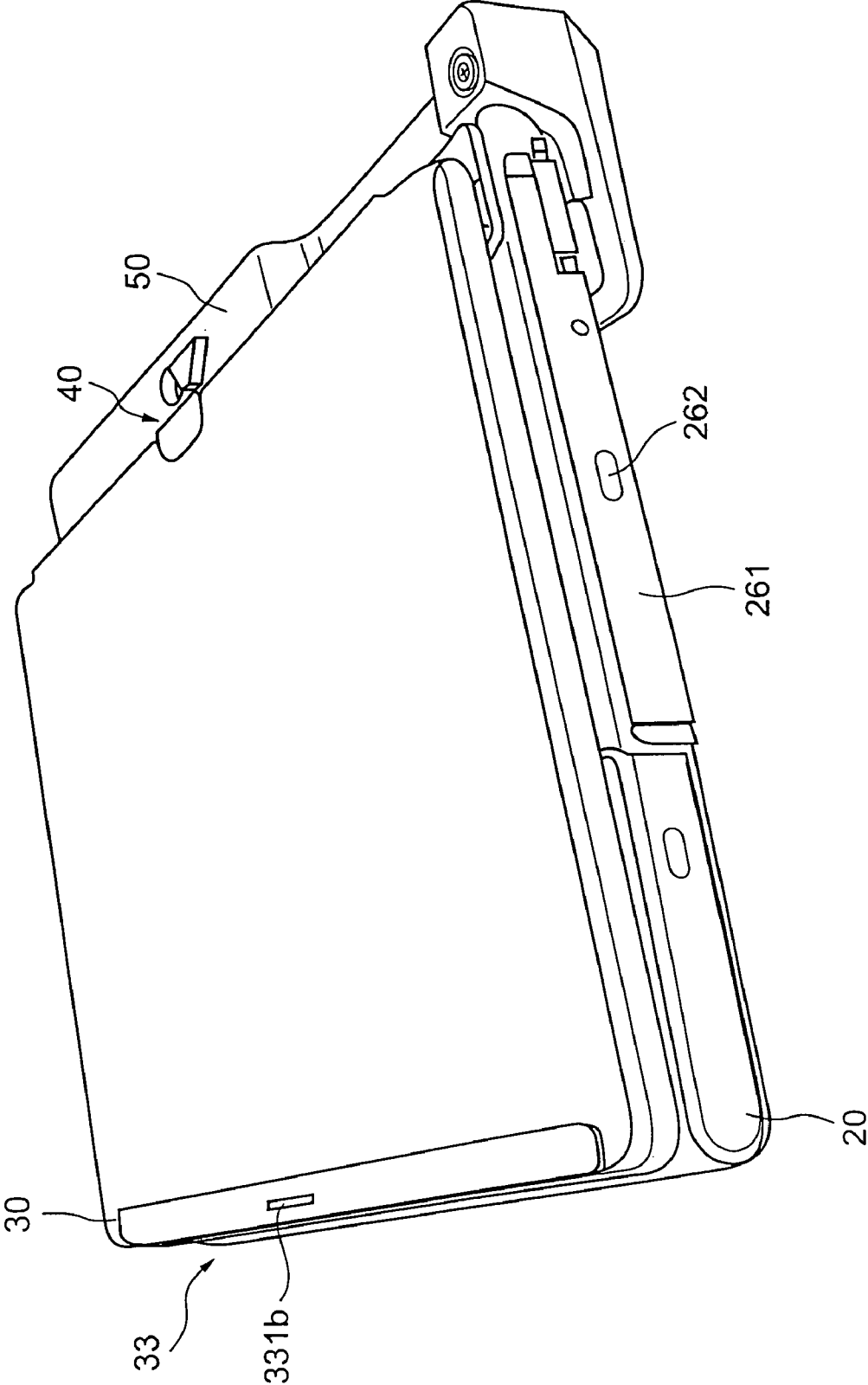


Fig. 5

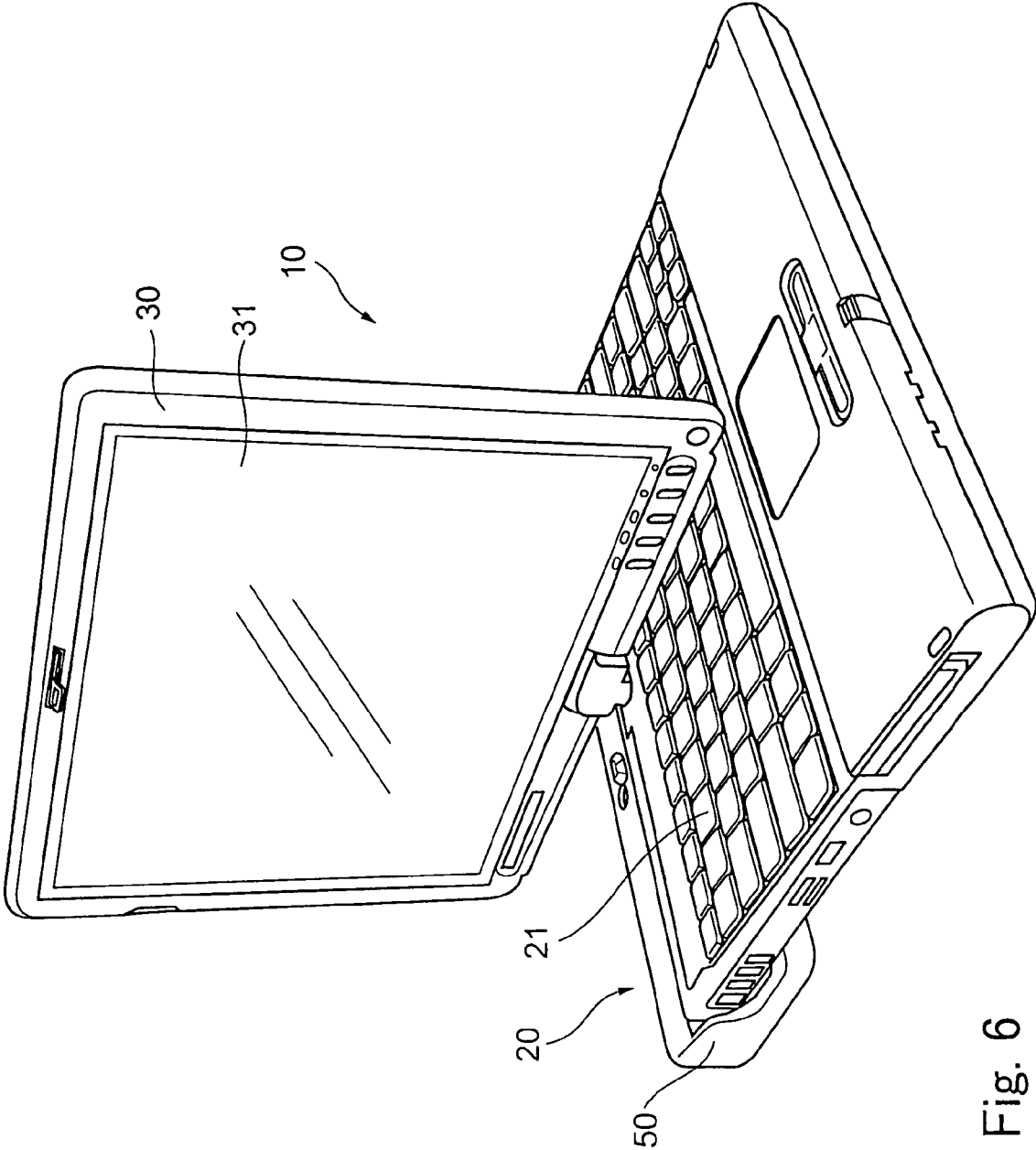


Fig. 6

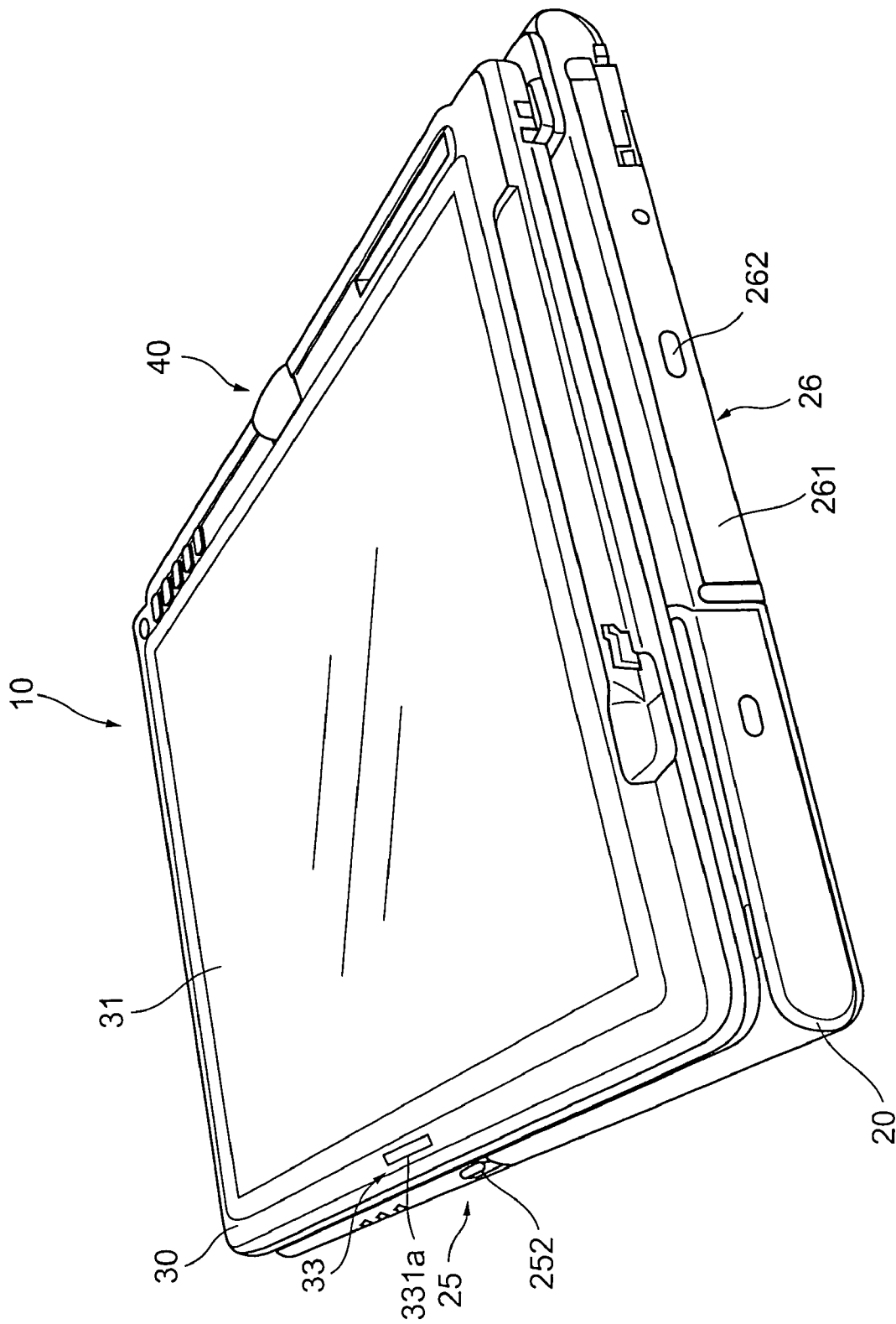


Fig. 7

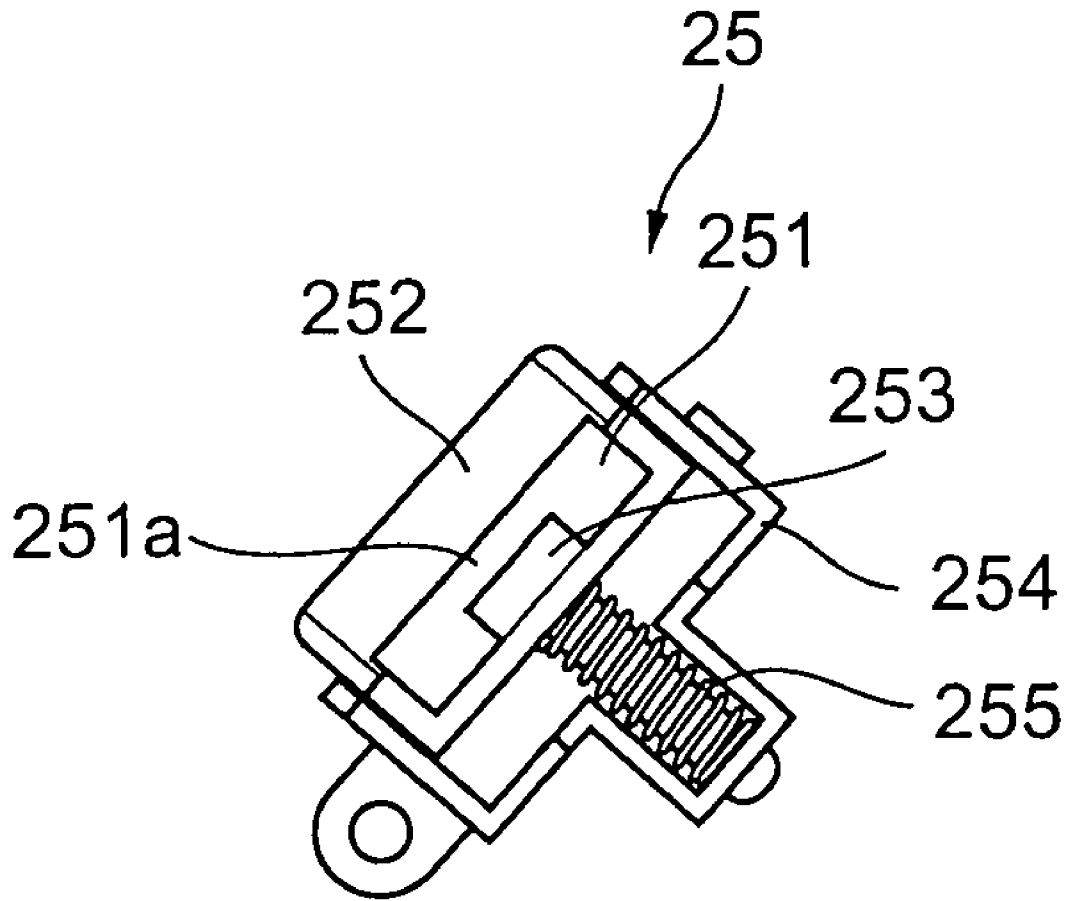


Fig. 8

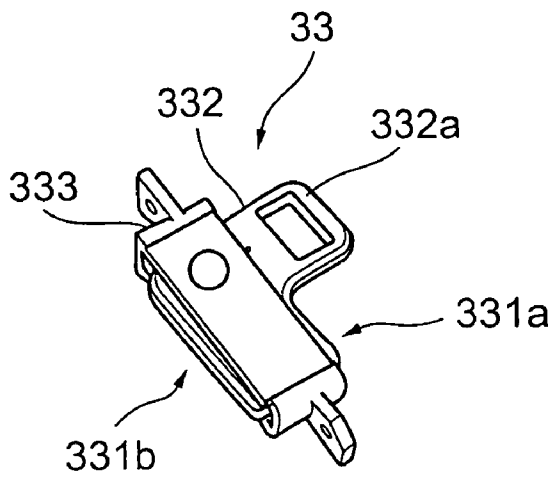


Fig. 9 A

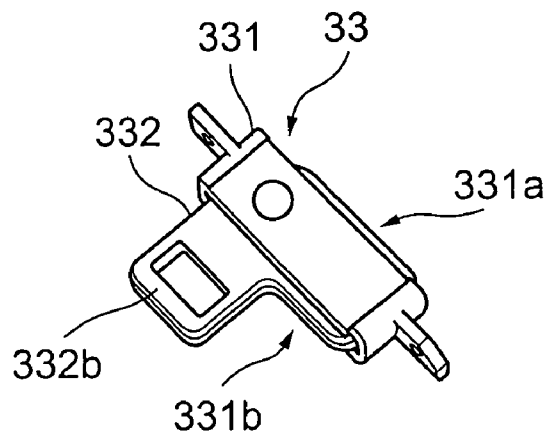


Fig. 9 B

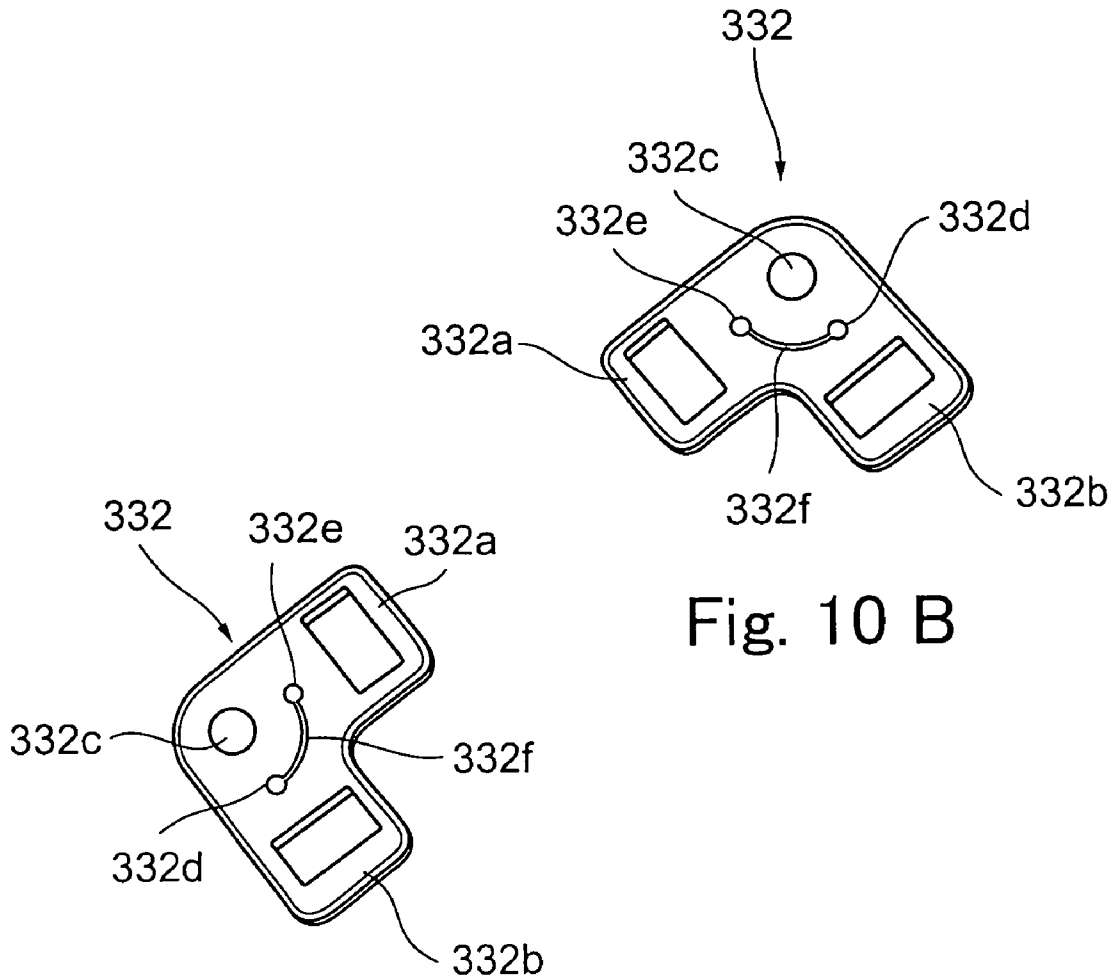
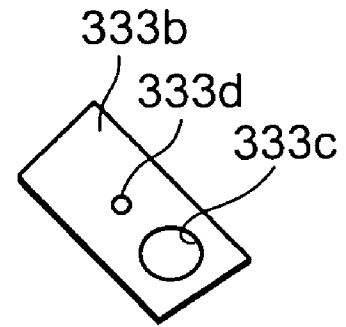
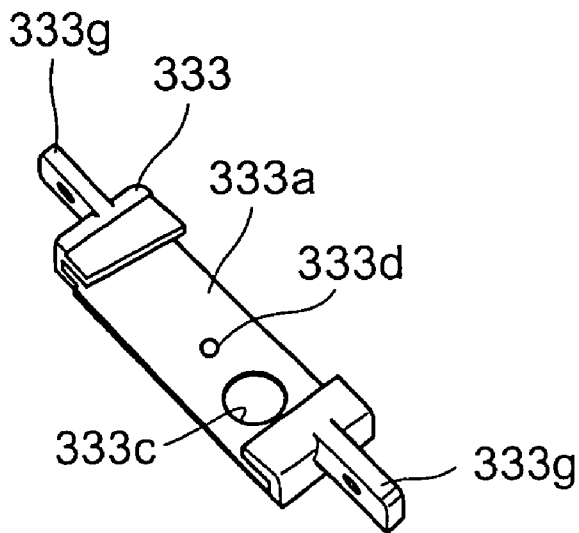


Fig. 10 B

Fig. 10 A



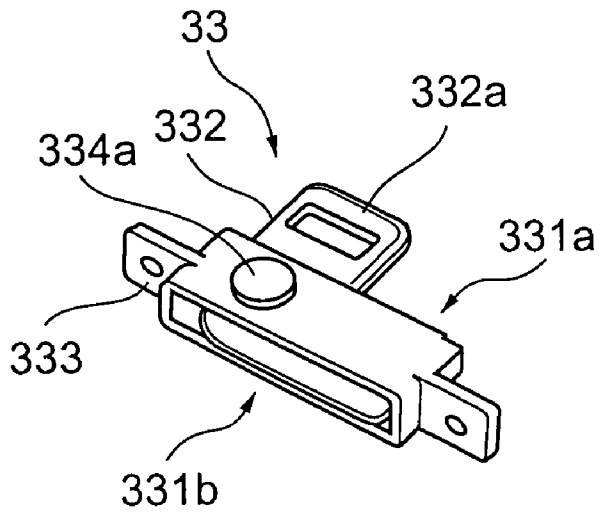


Fig. 12 A

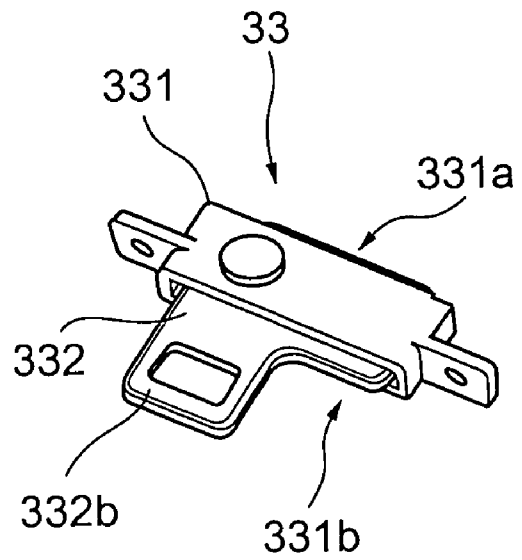


Fig. 12 B

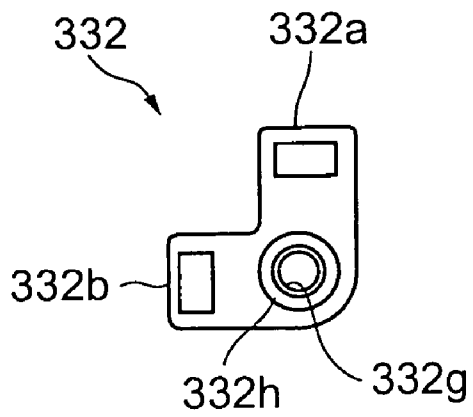


Fig. 13 A

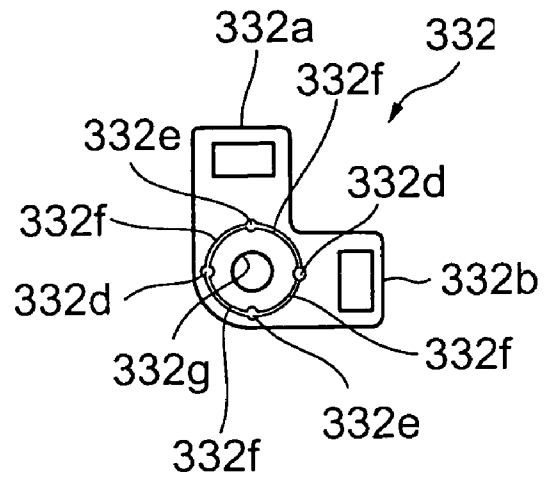


Fig. 13 B

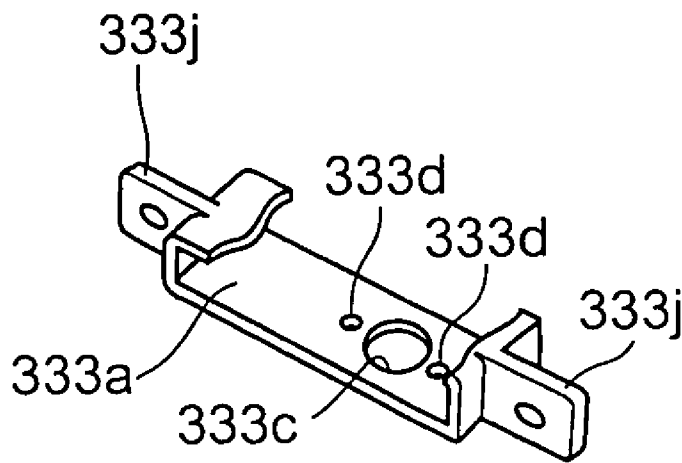


Fig. 14 A

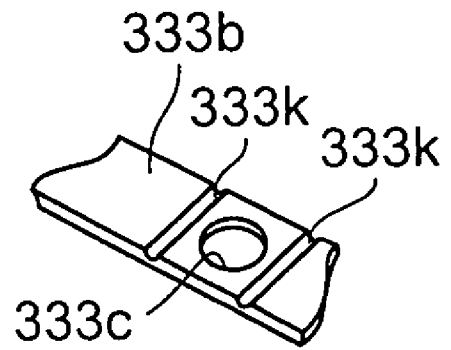


Fig. 14 B

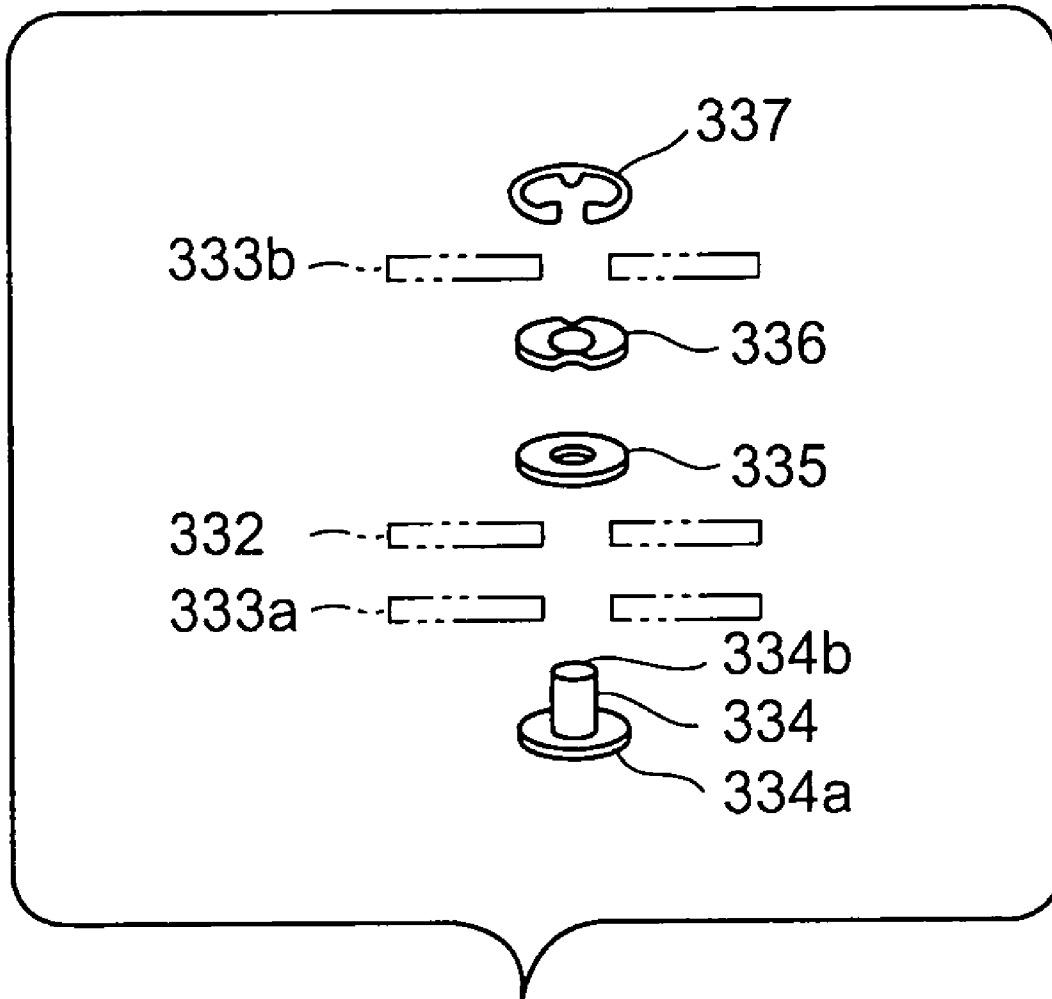


Fig. 15

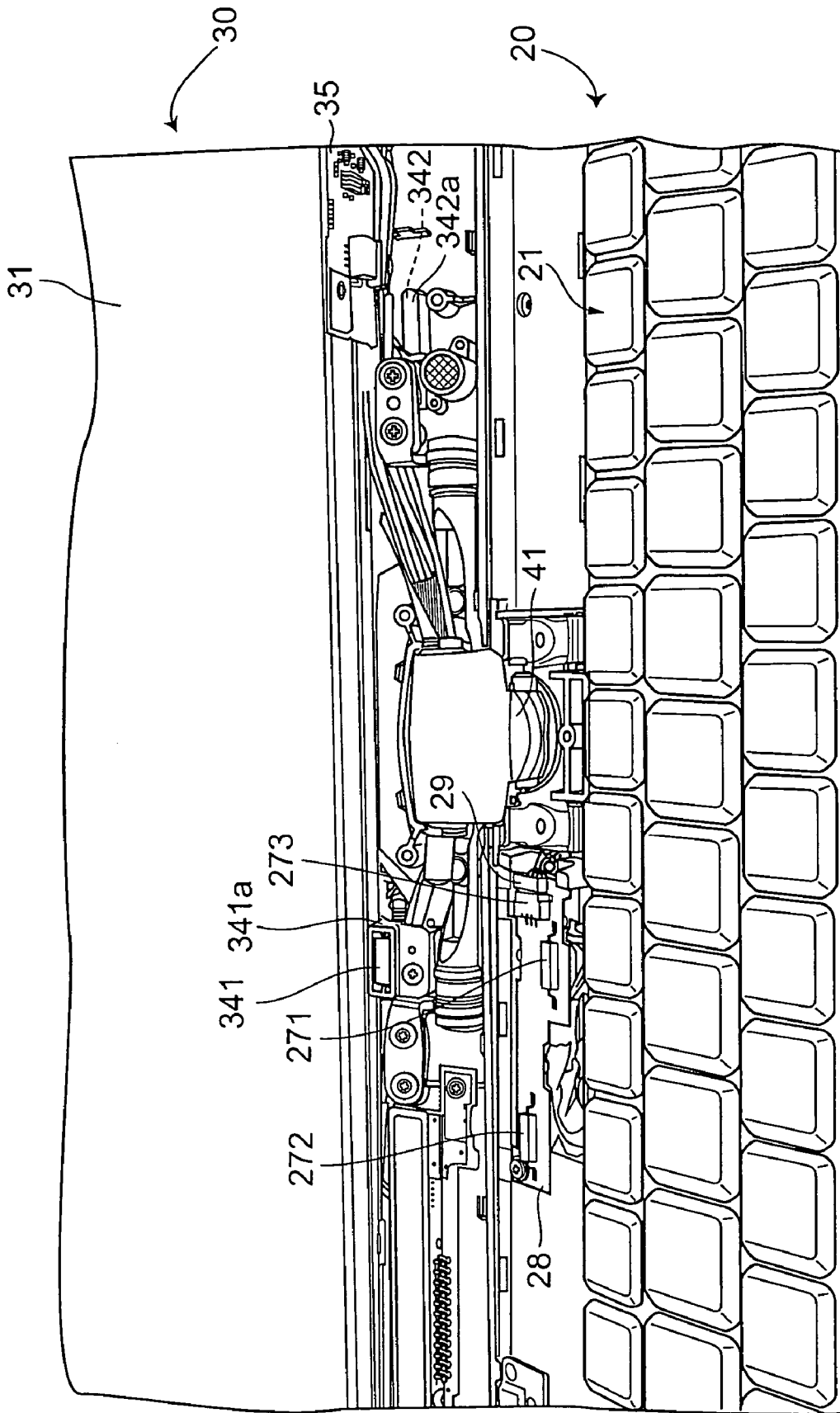


Fig. 16

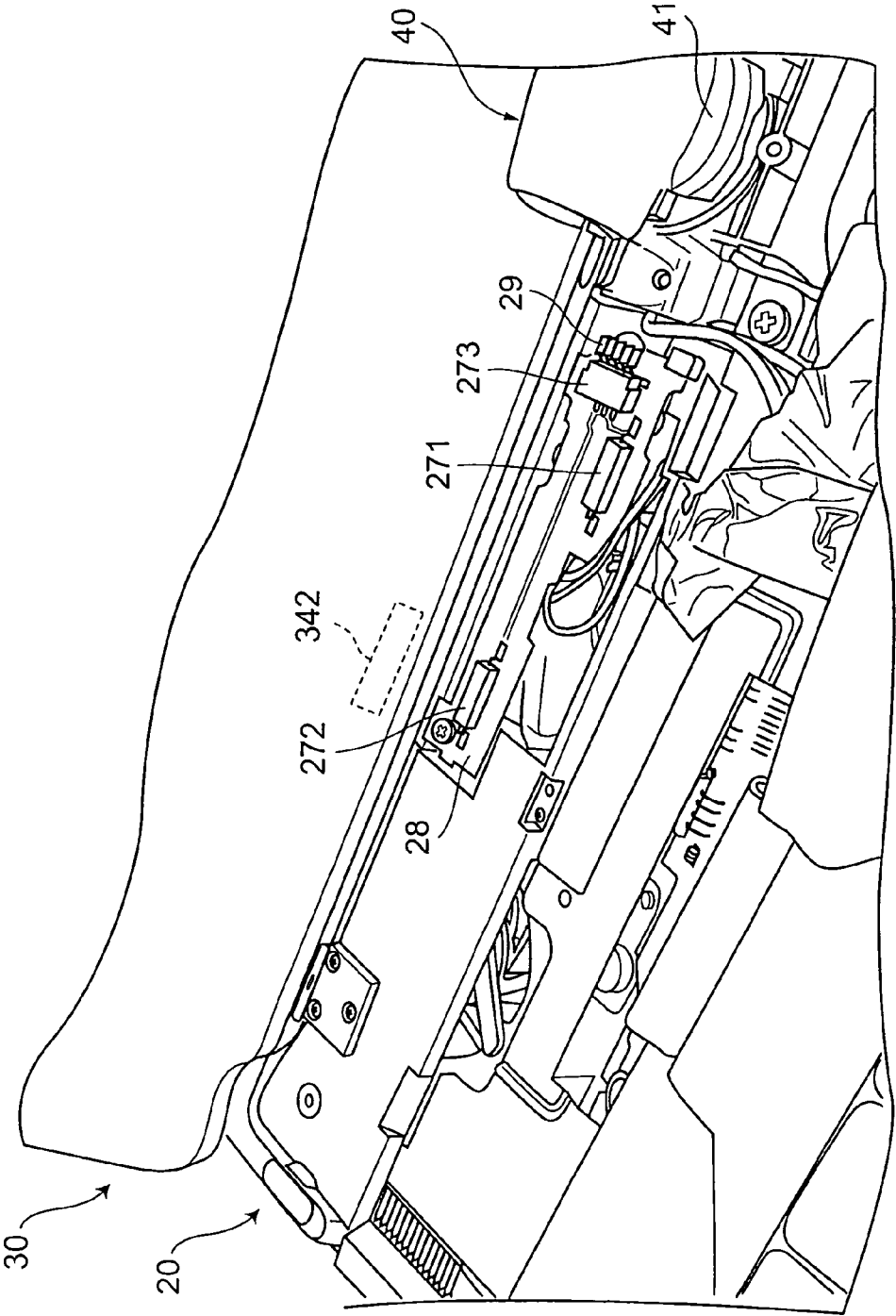


Fig. 17

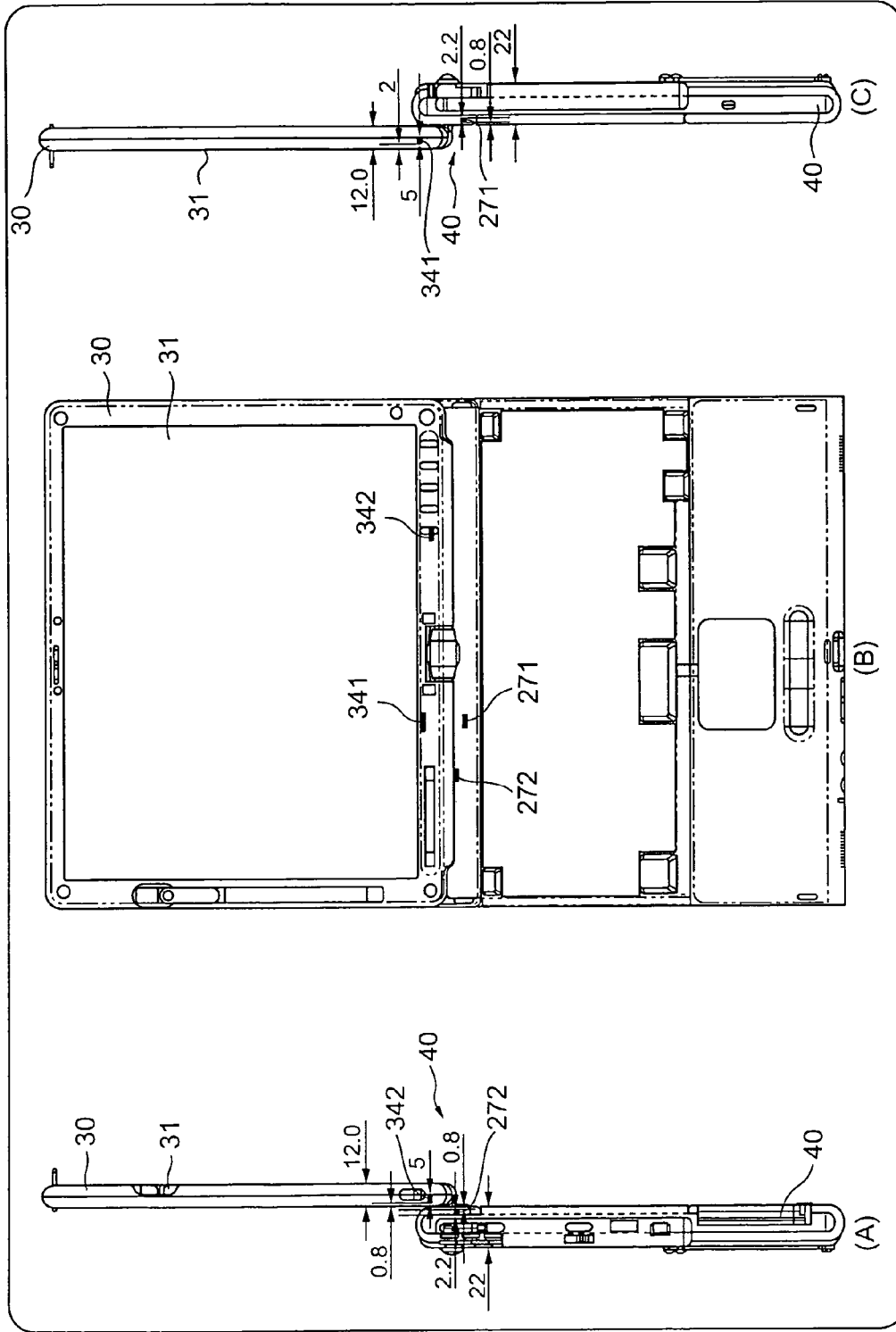


Fig. 18

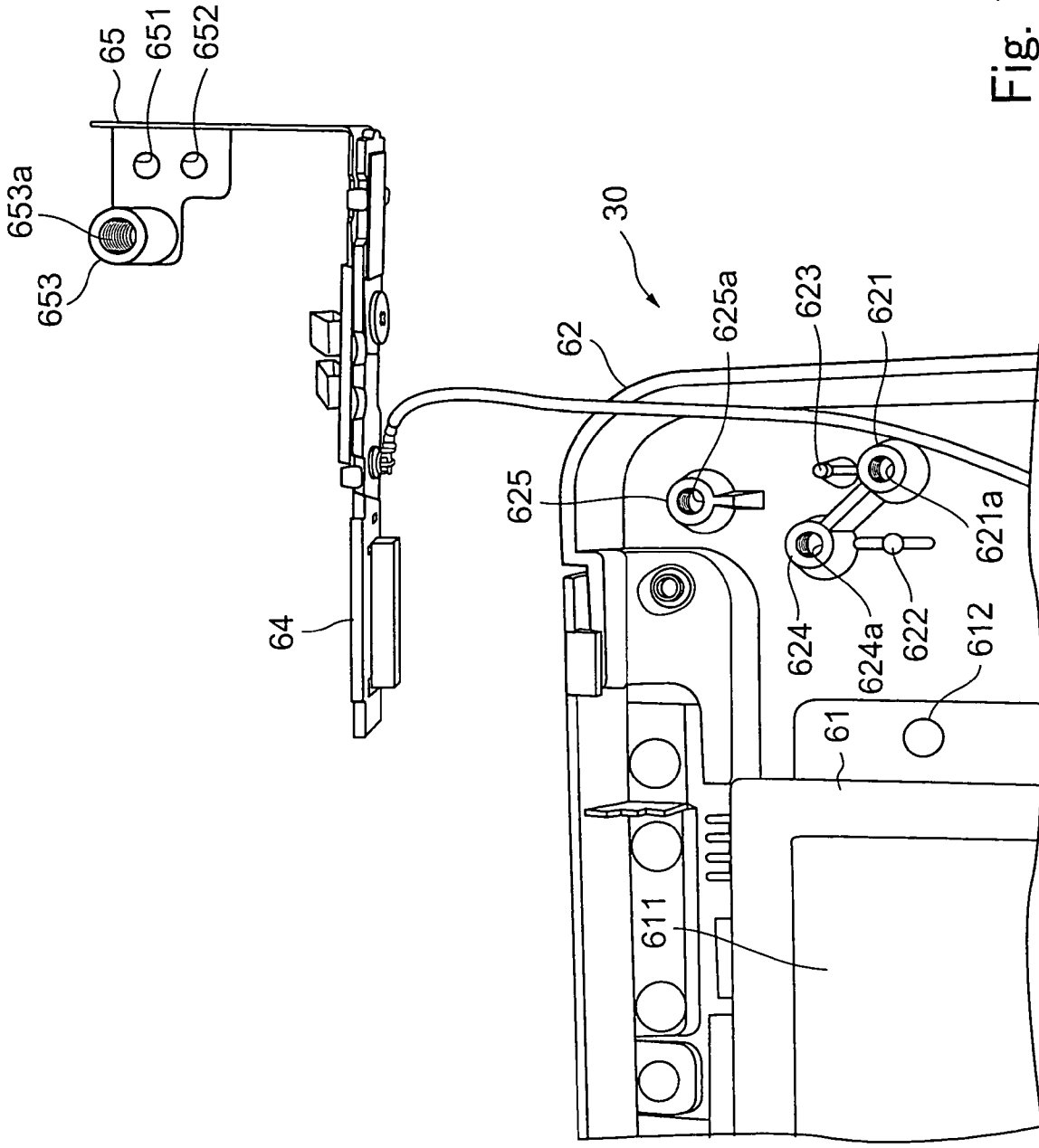


Fig. 19

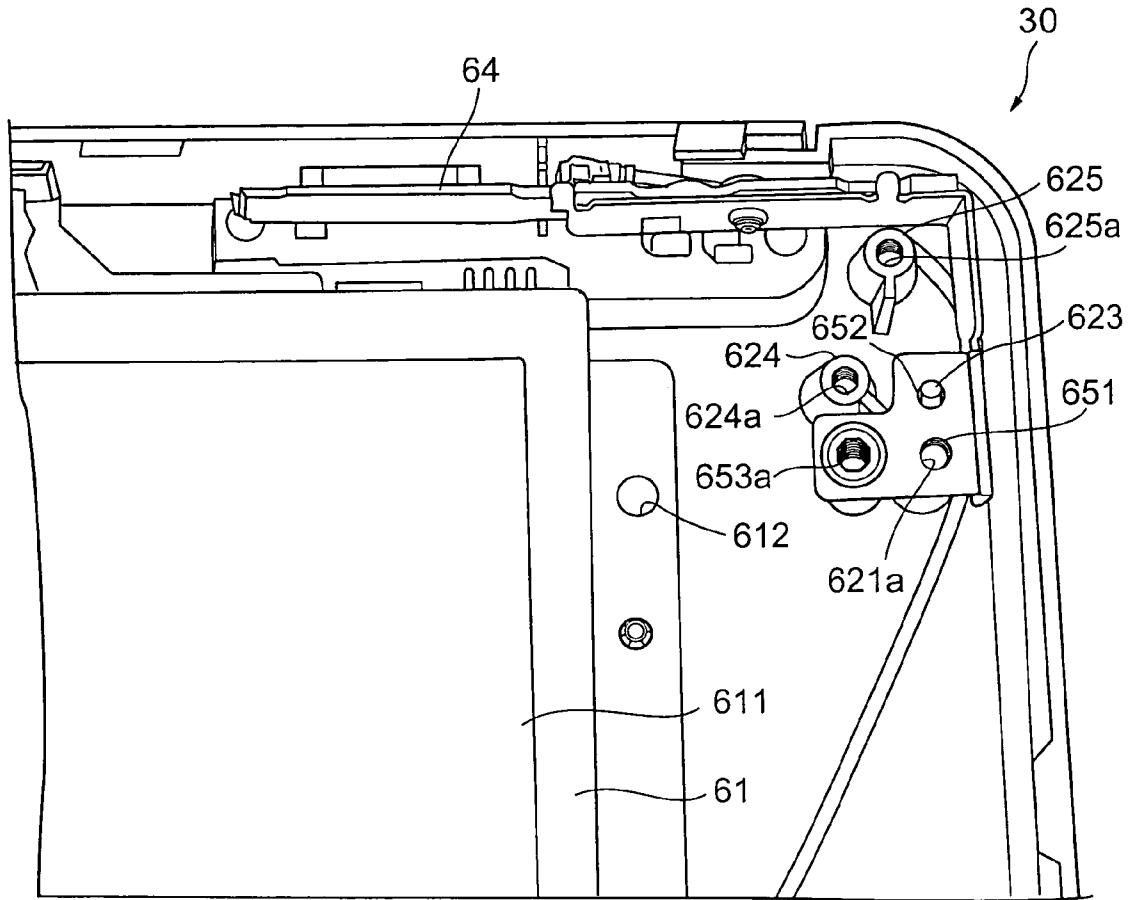


Fig. 20

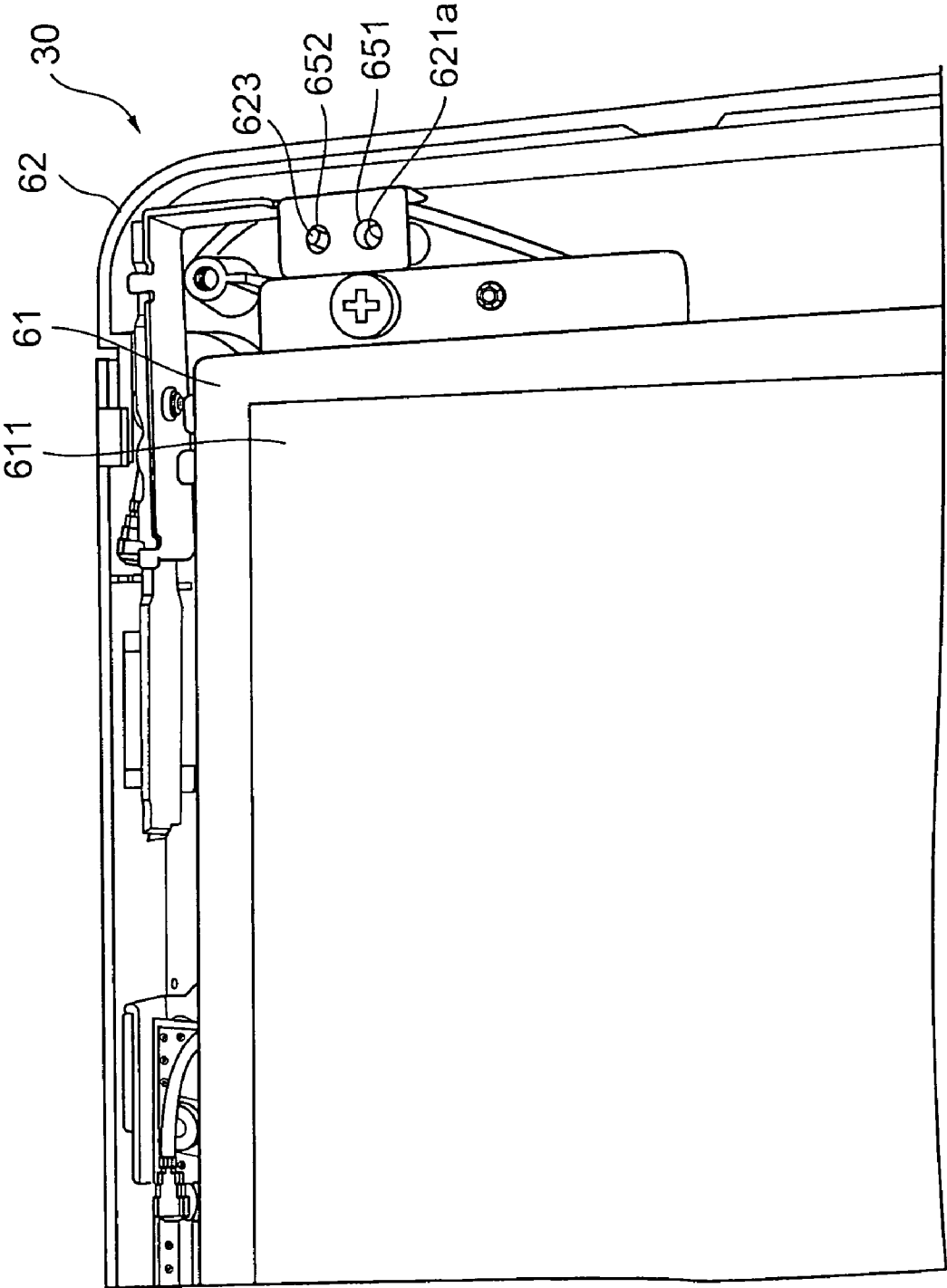


Fig. 21

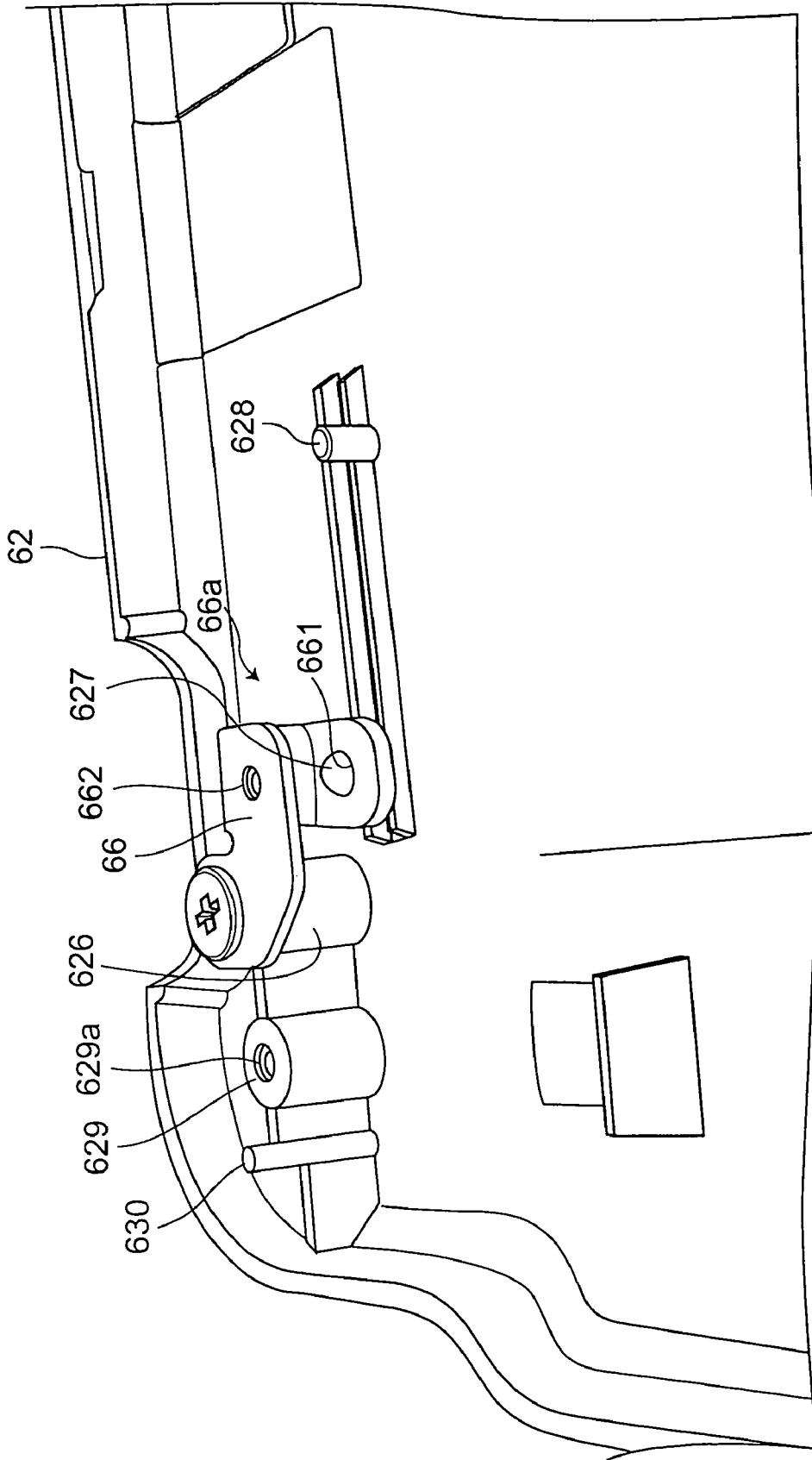


Fig. 22

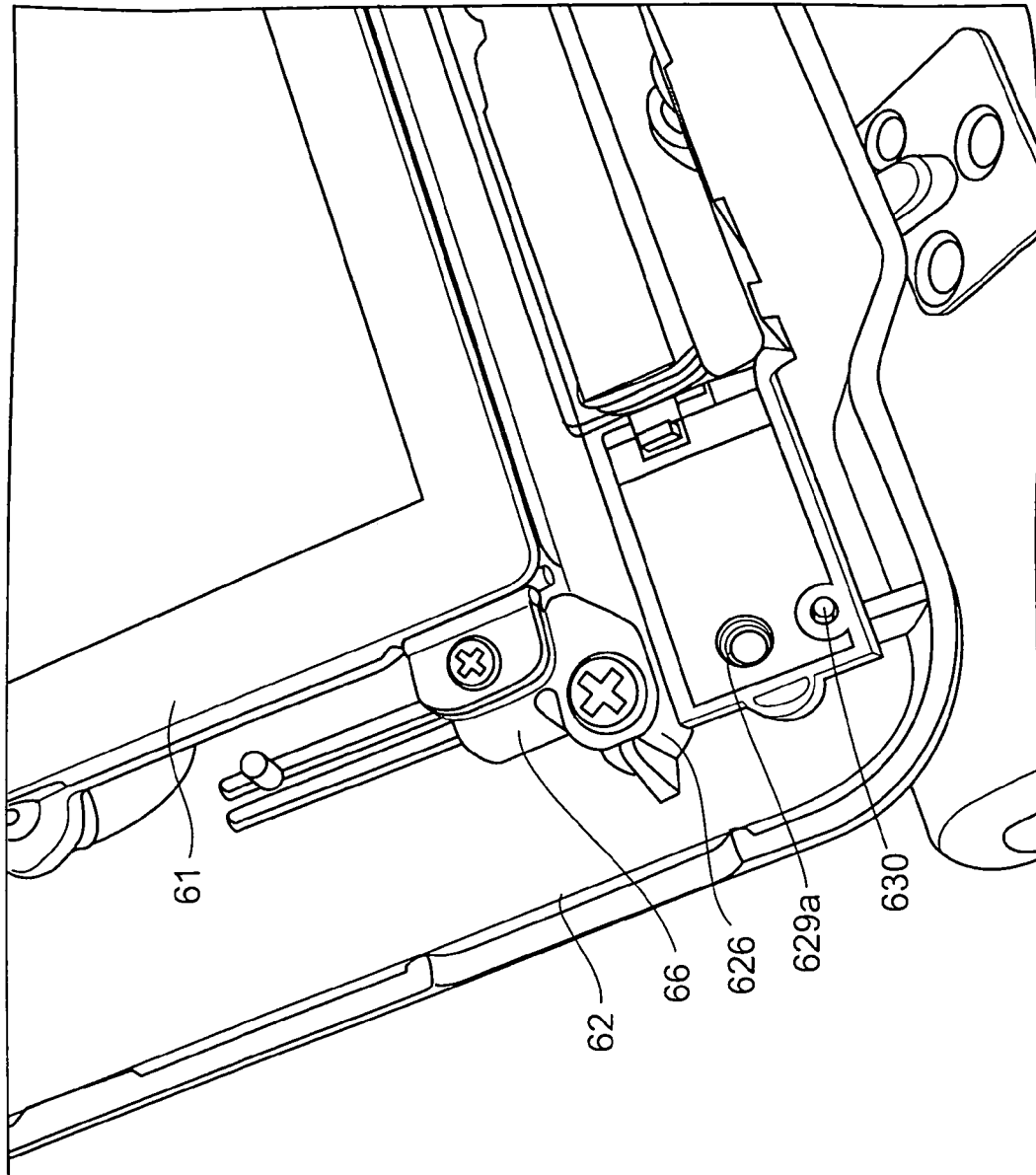


Fig. 23

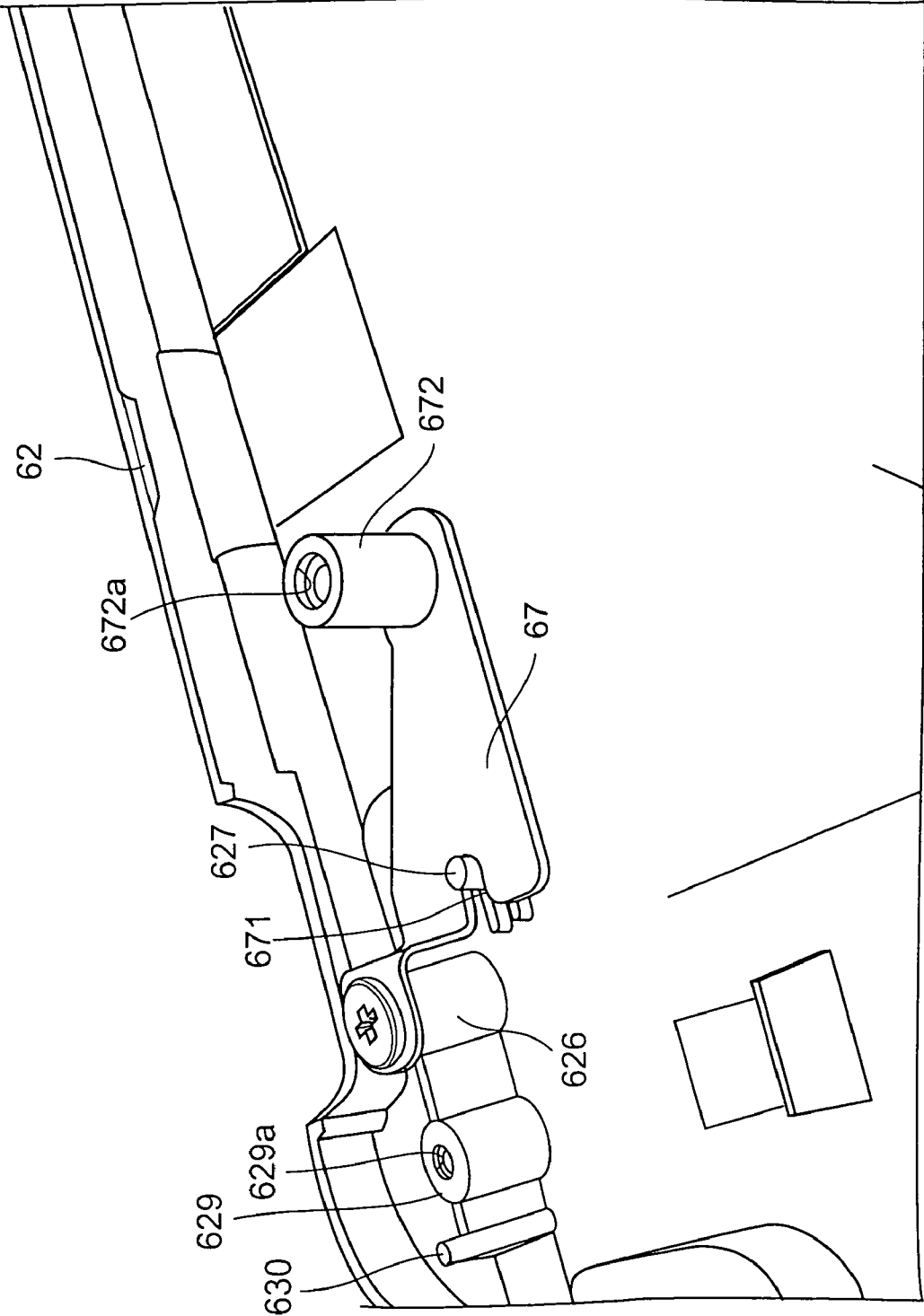


Fig. 24

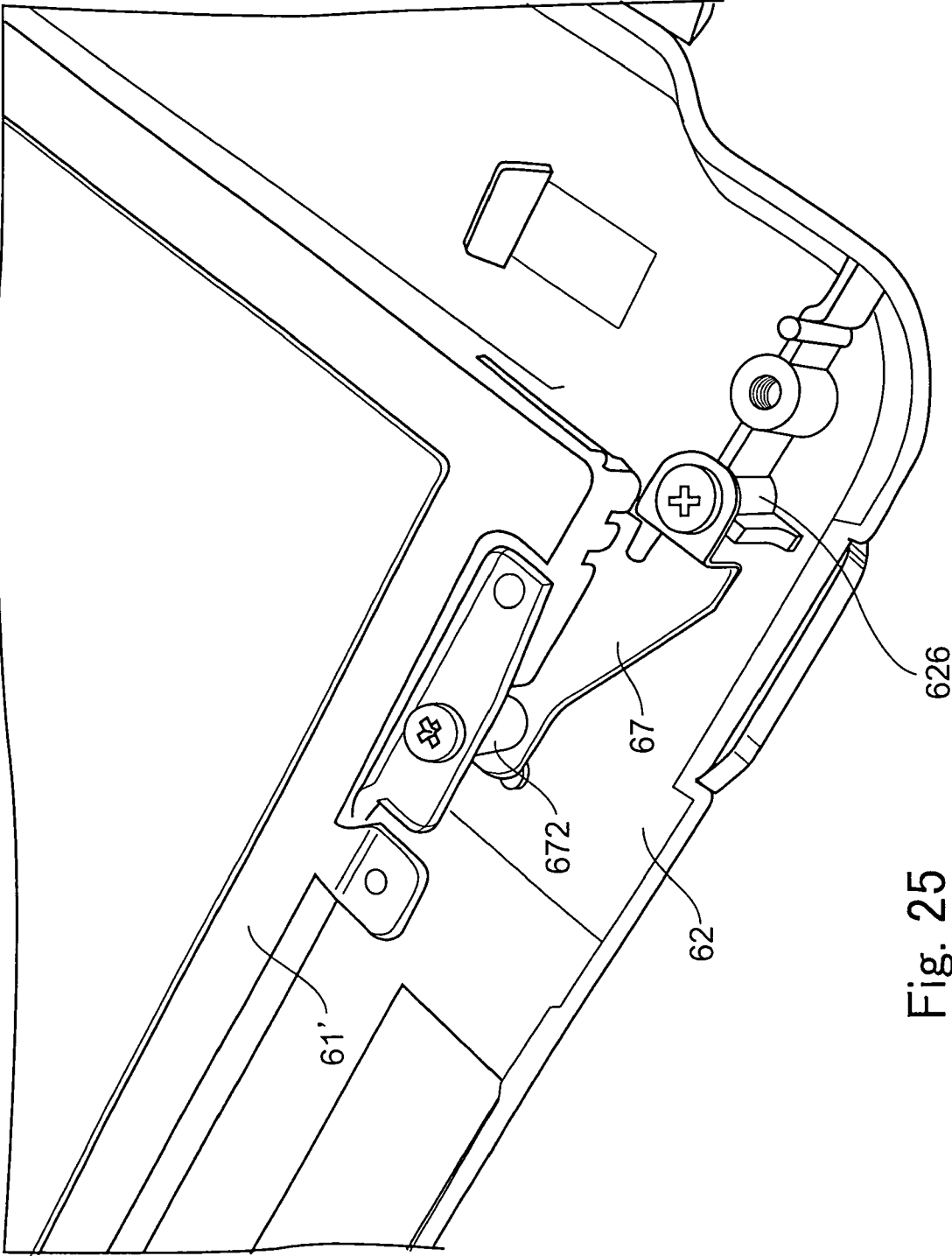


Fig. 25

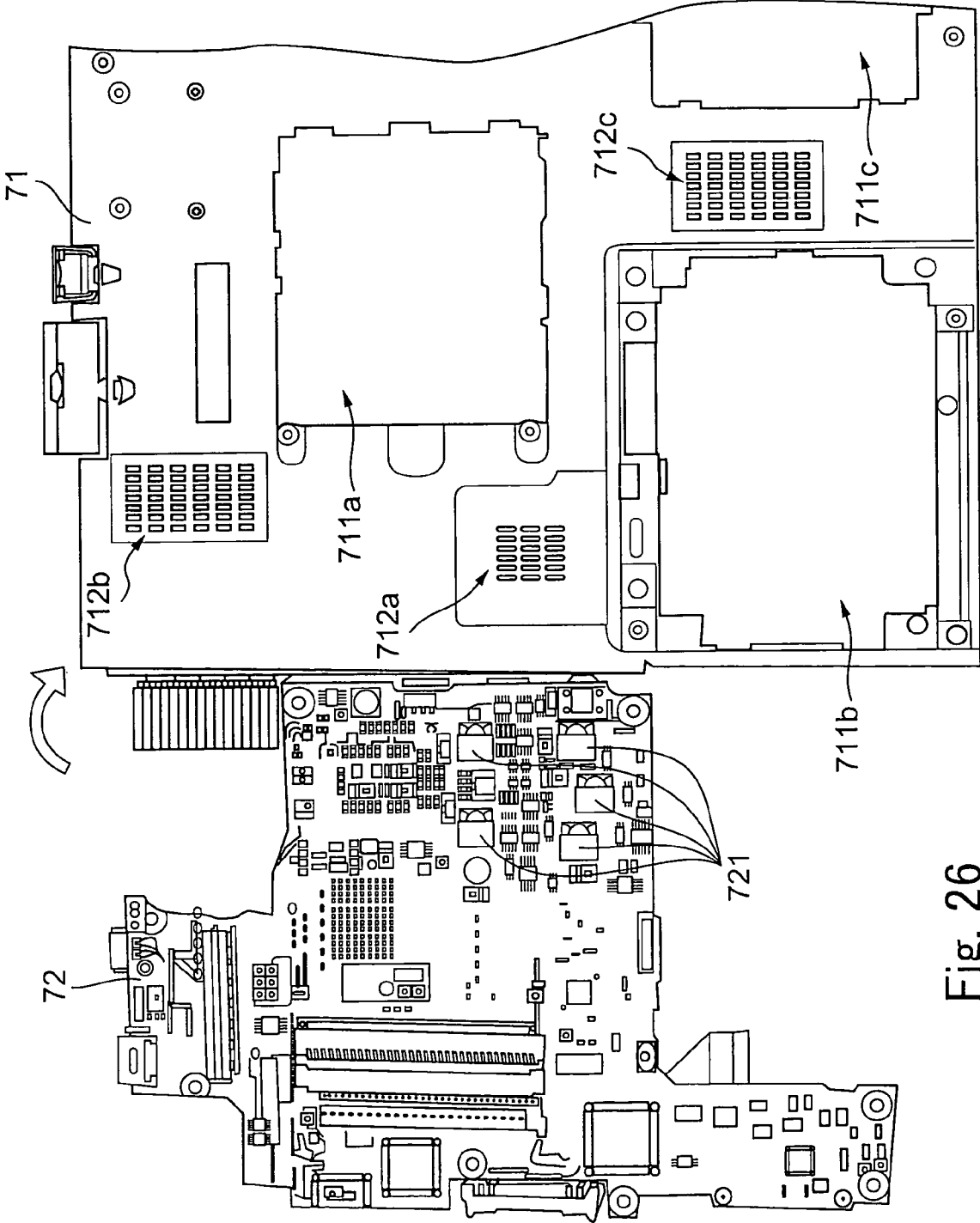


Fig. 26

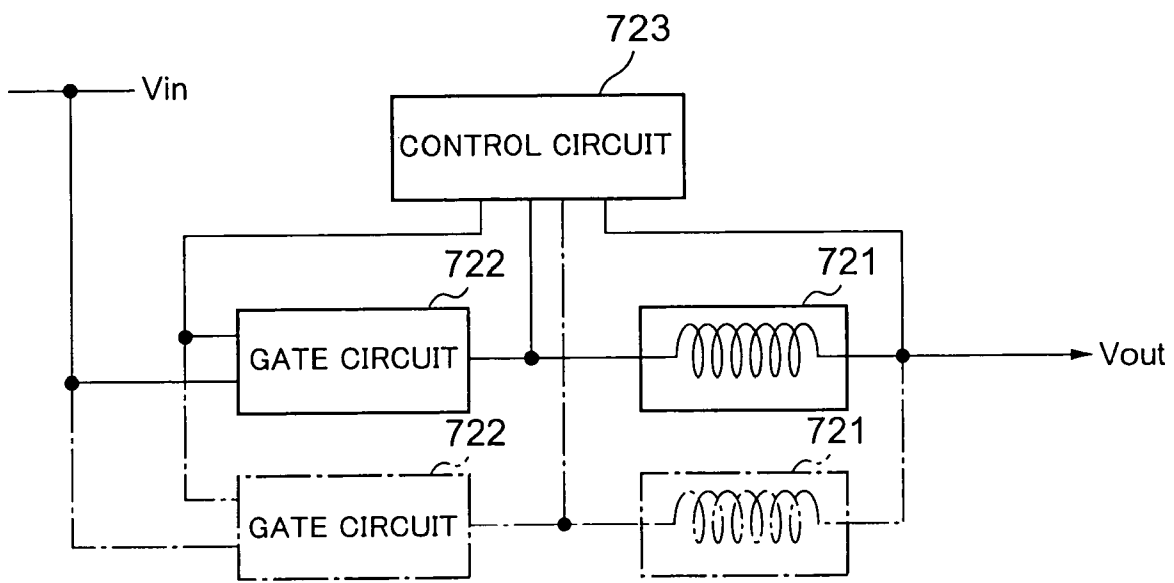


Fig. 27

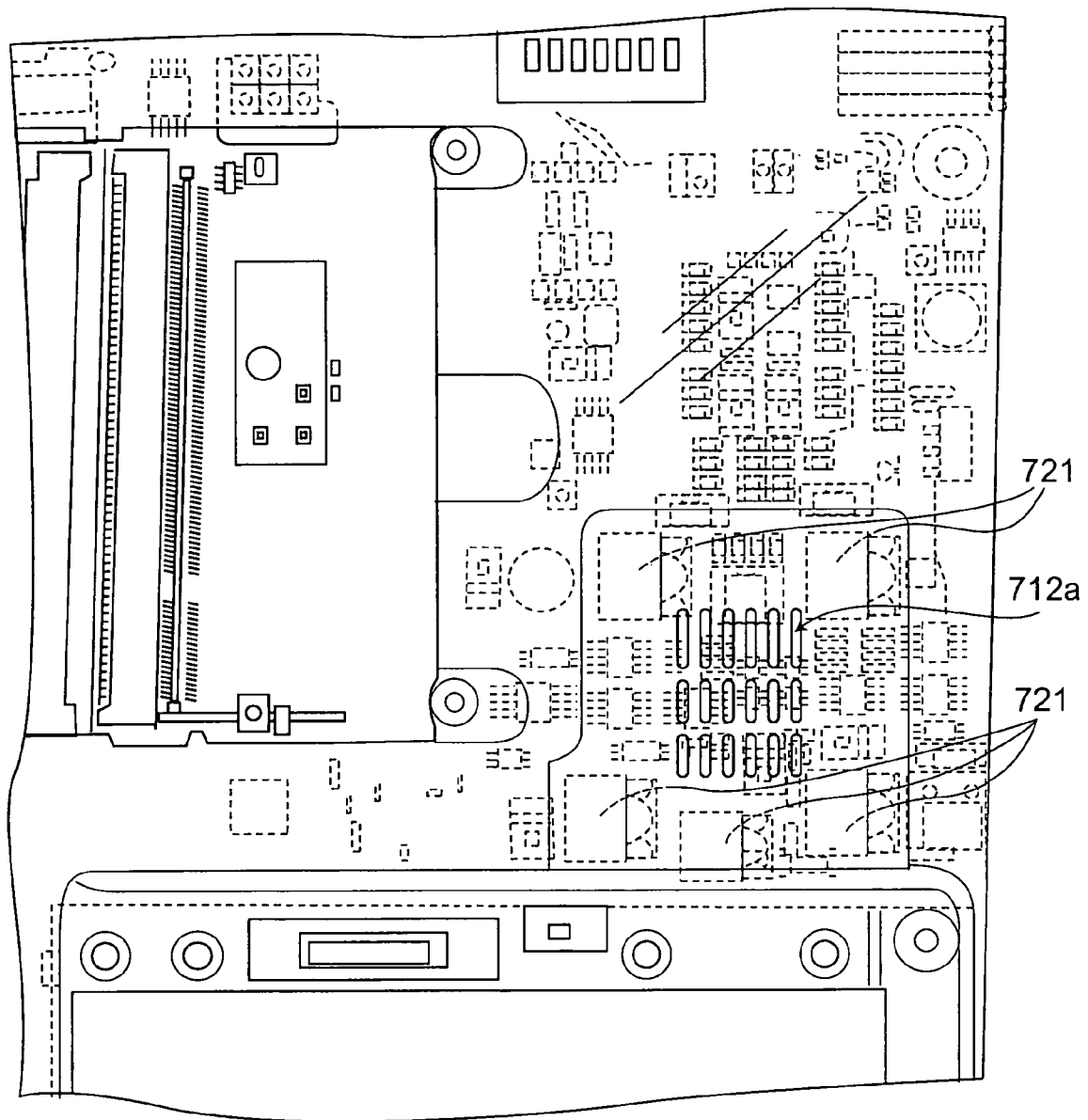


Fig. 28

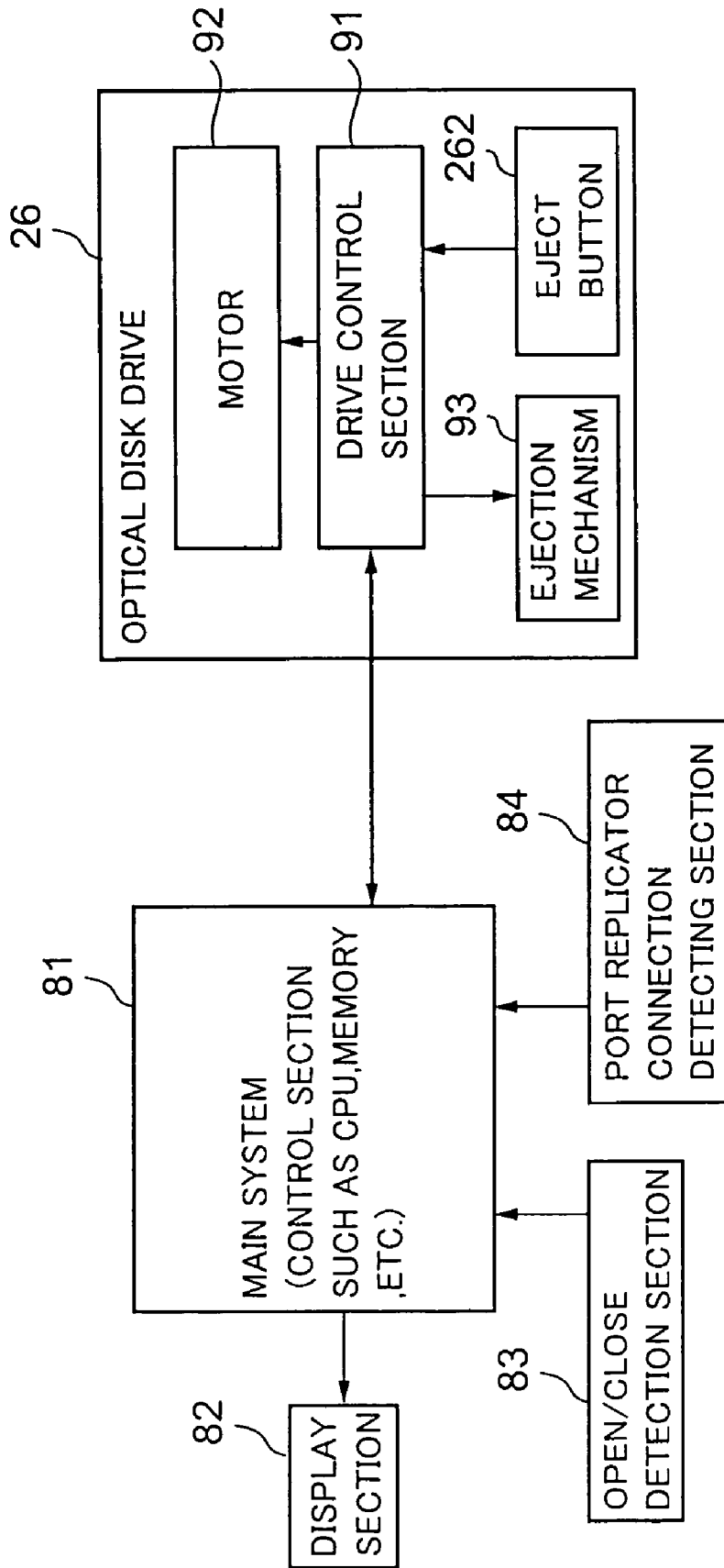


Fig. 29

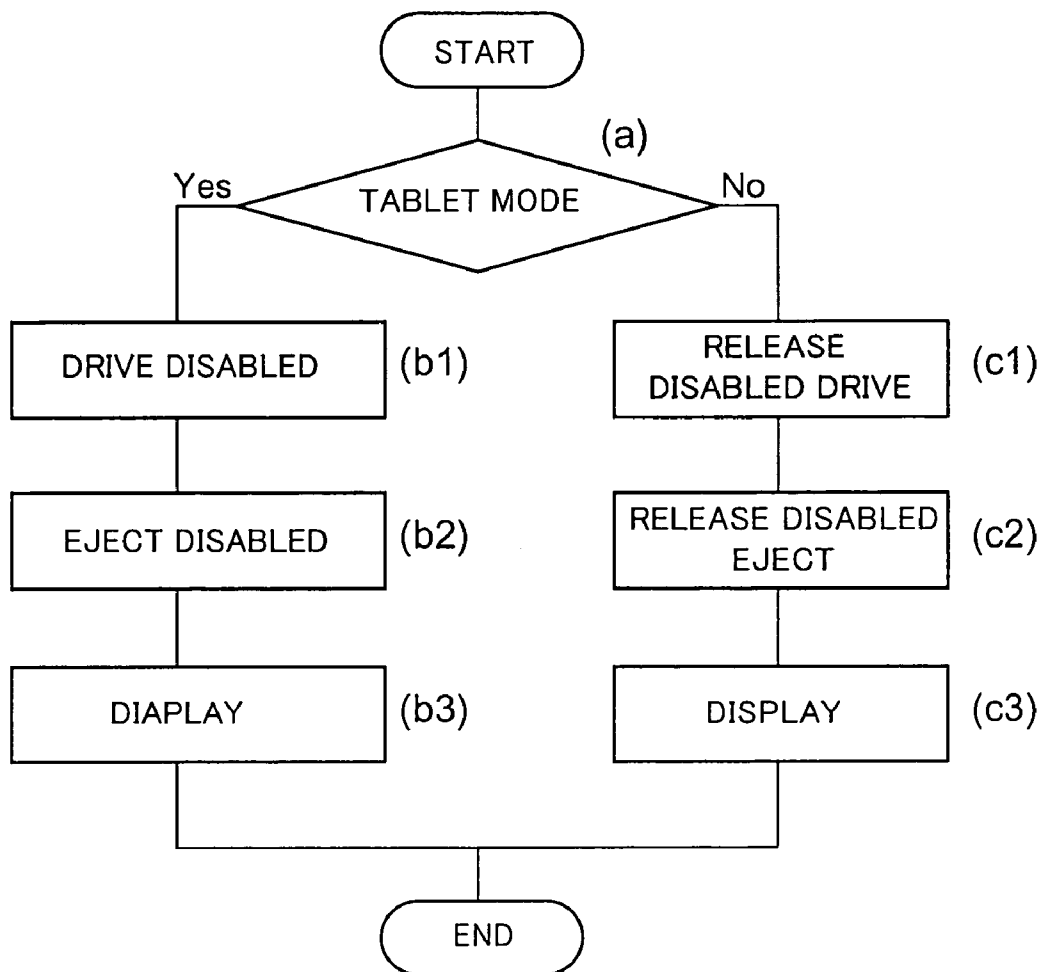


Fig. 30

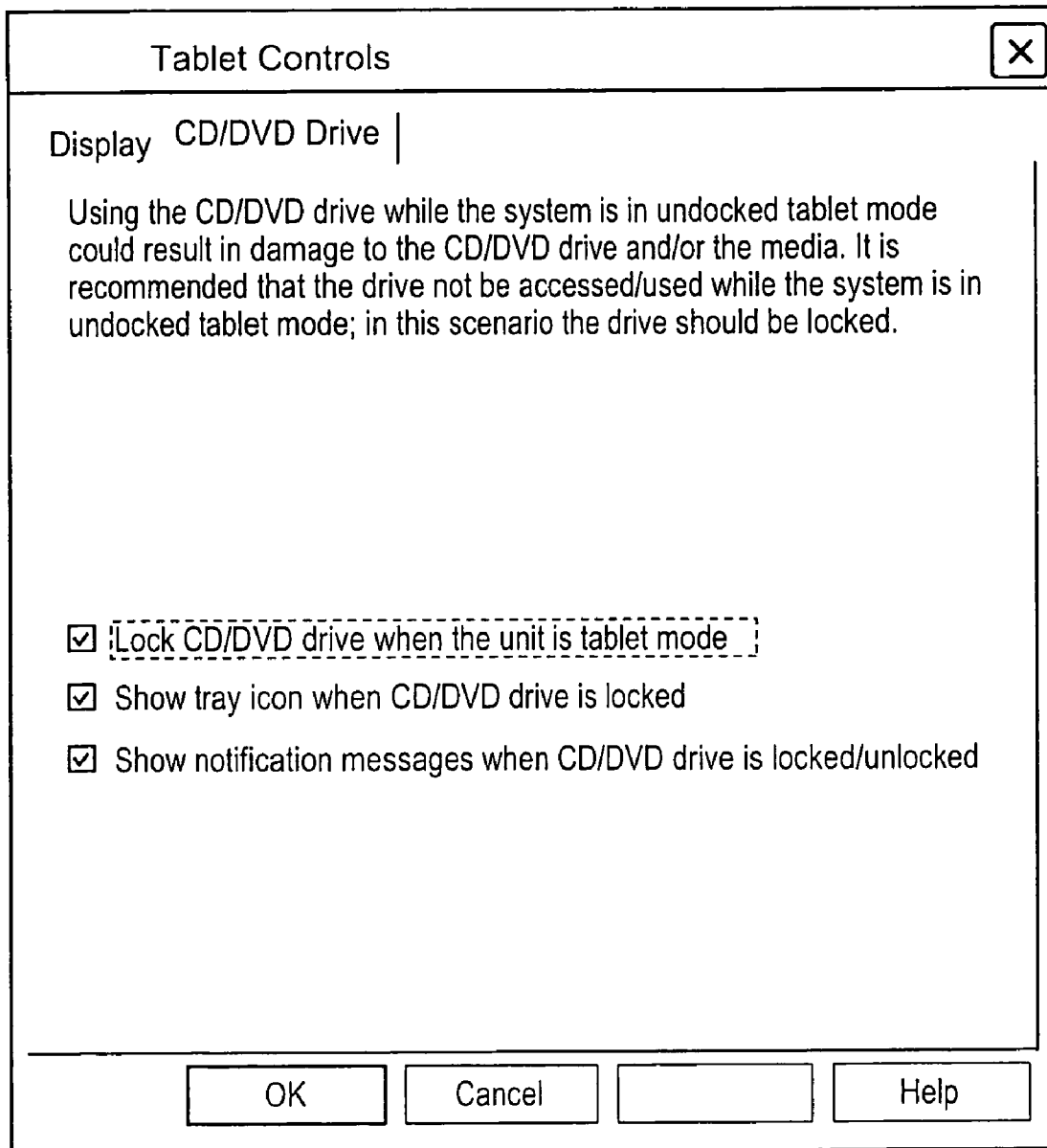


Fig. 31

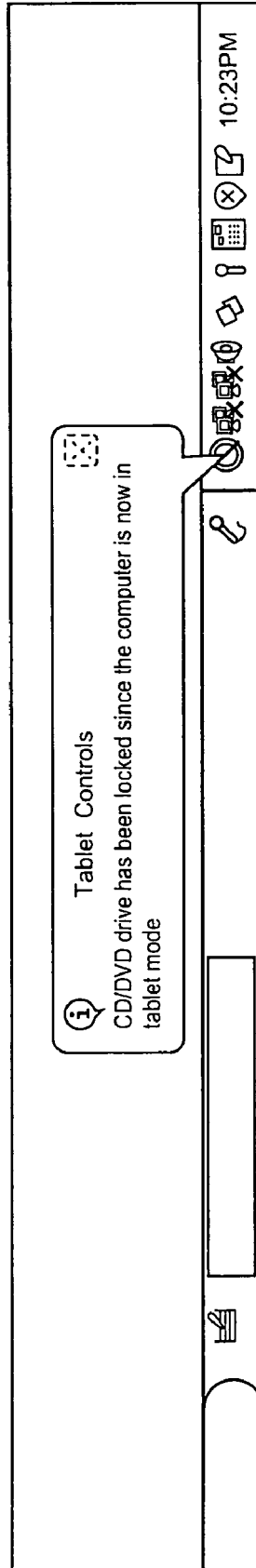


Fig. 32

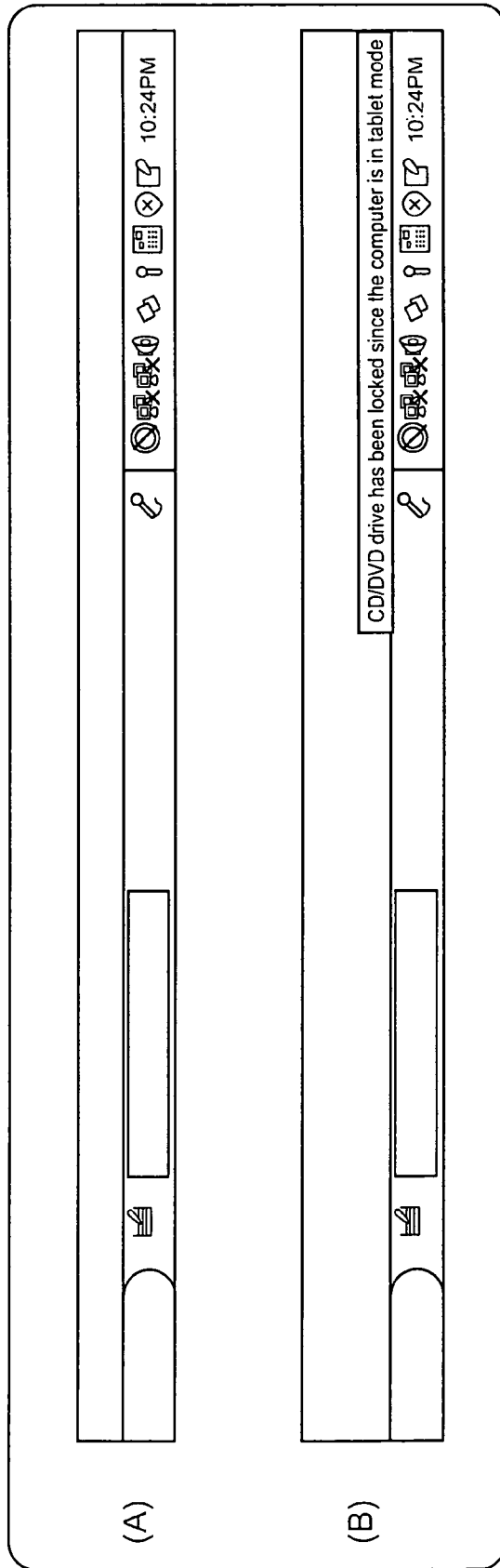


Fig. 33

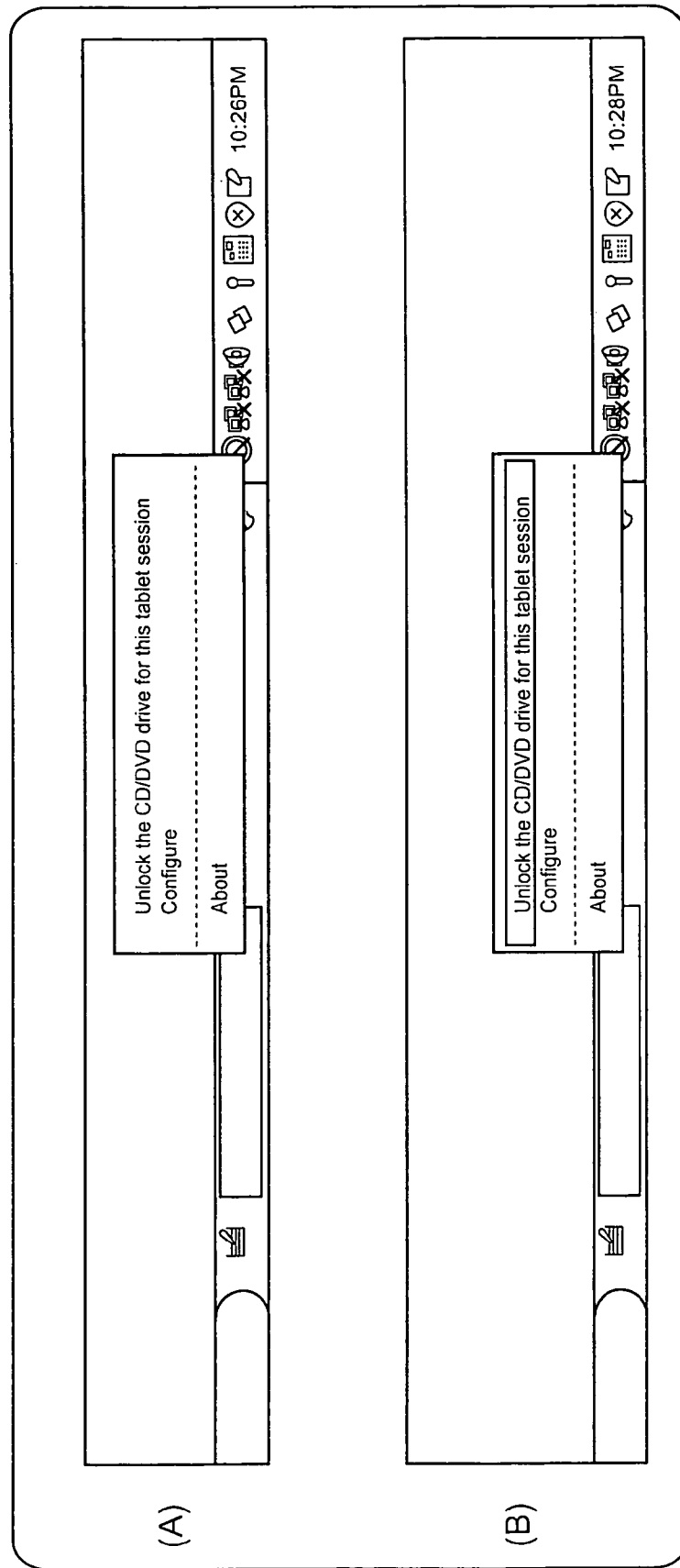


Fig. 34

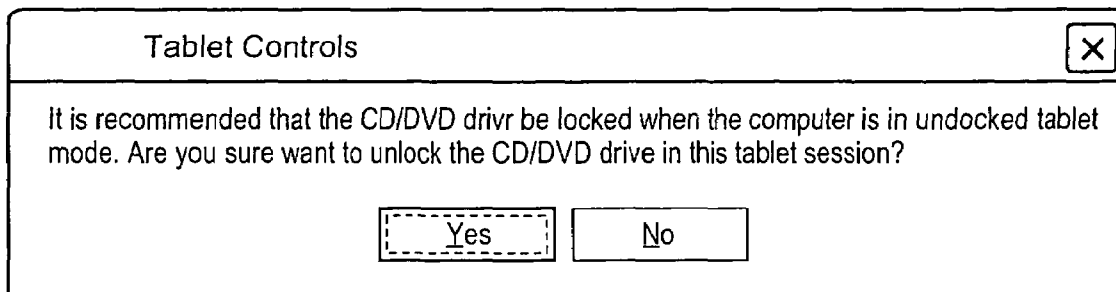


Fig. 35

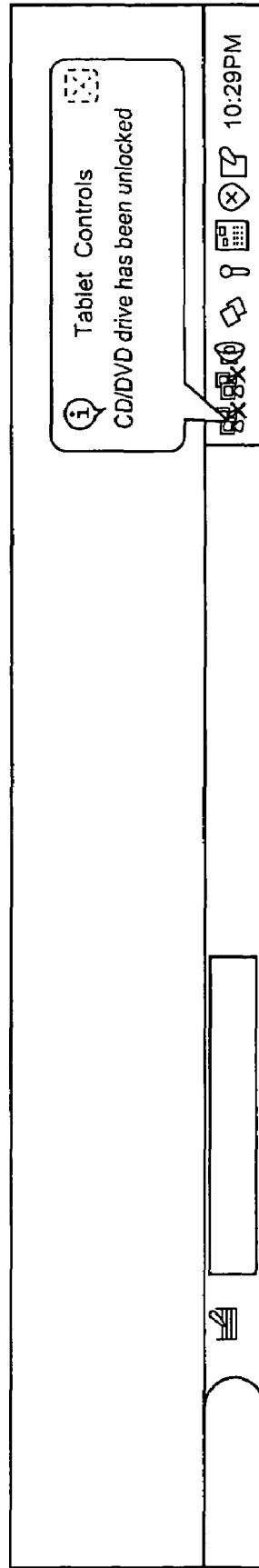


Fig. 36

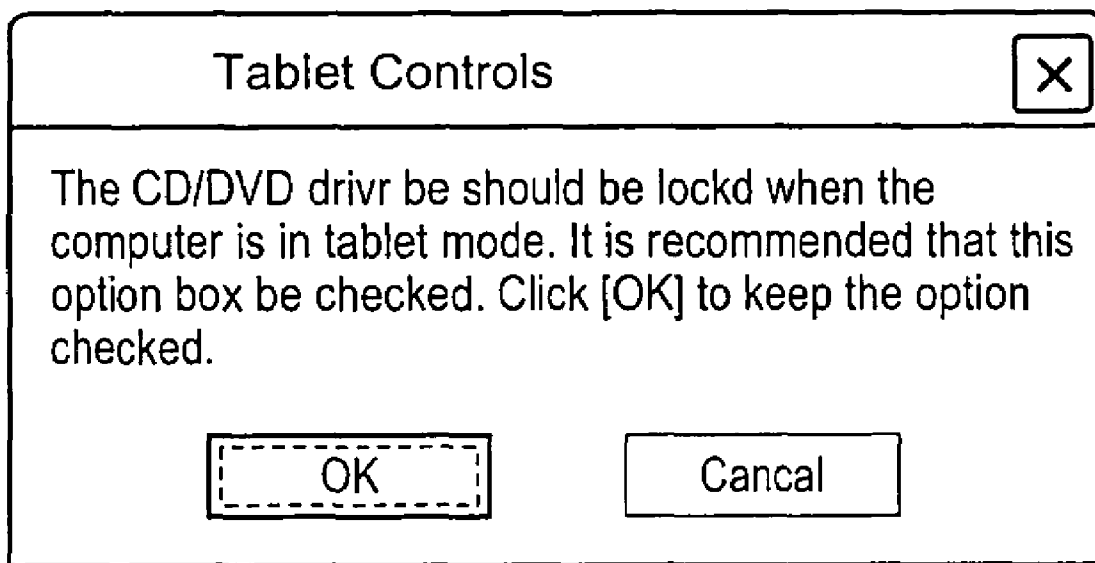


Fig. 37

ELECTRONIC APPARATUSCROSS-REFERENCE TO RELATED
APPLICATION

This application claims priority to Japanese Patent Application No. 2004-249259 filed on Aug. 27, 2004, the entire disclosure of which is incorporated by reference.

FIELD OF THE INVENTION

The present invention relates to an electronic apparatus that includes a first unit having a keyboard and a second unit having a display screen, in which the second unit is coupled to the first unit through a two-axis coupling section to be opened, closed, and rotated relative to the first unit.

BACKGROUND OF THE INVENTION

Typically, electronic apparatus such as notebook or laptop computers have a first unit having a keyboard that is coupled by hinges to a second unit having a display screen, such that the two units can be opened and closed relative to each other. When the apparatus is used, the second unit is opened, and when it is not used, the second unit is closed such that the display screen lies on the keyboard. This type of apparatus is well known as a notebook personal computer (hereinafter referred to as a notebook PC).

Another type of portable computer includes a display screen, wherein the display screen is configured to recognize a stylus or pen-like device that is placed close to or in contact with the screen to enable user input. This type of apparatus is well known as a tablet personal computer (hereinafter referred to as a tablet PC).

Recently, convertible tablet/notebook computers have become available with the first unit and the second unit coupled through a two-axis coupling device which allows rotation of the second unit in two directions relative to the first unit. This configuration allows the computer to be used either as a notebook PC with the display screen projecting upward from the keyboard, or as a tablet PC with the display screen resting facing up on the keyboard (refer to Japanese Patent Application Publication No. 11-312876).

As for Notebook PCs, typically, a projection for detecting the opened/closed status of the display screen (second unit) relative to the keyboard (first unit) is provided in the rear of the keyboard disposed on the top surface of the first unit. When the second unit is closed, the projection is pushed into the second unit so that the closed status is detected. This is an open/close detection means. In this case however, it happens that the user's finger accidentally touches the projection causing the notebook PC to incorrectly recognize that it has entered the closed status.

Some notebook PCs incorporate another type of open/close detection means in which a small hole is formed in the rear of the keyboard of the first unit whereas a projection to be inserted into the hole is formed below the display screen of the second unit. When the second unit is closed, the projection is inserted into the hole so that the closed status is detected. In this case, the hole is smaller than the tip of a finger, which prevents the notebook PC from incorrectly recognizing that it has entered the closed status unlike the previously mentioned open/close detection means.

Some convertible tablet/notebook computers are well known for having a rotation detection means for detecting the direction of the second unit (display screen) in addition to the

open/close detection means of the notebook PCs. This type of computer has the following deficiencies.

In order to change the convertible tablet/notebook computers from notebook PC mode to table PC mode, the user turns the display screen facing forwards by 180° so that the back of the display screen faces forwards and the user lays the back of the display screen on the keyboard.

The rotation detection means is to detect the change of the direction of the display screen to turn images displayed on the display screen by 90° because, typically, images displayed on the display screen in notebook PC mode need to be turned 90° to be displayed in table PC mode in convertible tablet/notebook type of computers. Thus, if the user turns the display screen 180° to change the computer from notebook PC mode to tablet PC mode, the rotation detection means detects the change of the direction of the display screen so that images displayed on the display screen is turned 90°. However, there occurs the following unfavorable situation. During the use in notebook PC mode with the display screen opened, the user may turn the display screen 180° to show it to the person opposite to the user. Then the images are unexpectedly turned 90° for use in table PC mode because the change of the direction of the display screen is detected by the rotation detection means. The images turned 90° are difficult to see for the person opposite to the user because the orientation of the images on the display screen is still in notebook PC mode.

Also, the open/close detection means incorporated in convertible tablet/notebook computers has the following deficiency. As mentioned before, the open/close detection means of the type having a projection arranged below the display screen has no problem when it is incorporated in the notebook PCs. However, if this type of open/close detection means is incorporated in a convertible tablet/notebook computer, the projection projects from the top surface of the closed computer when the computer is in table PC mode, i.e. the projection projects upward beside the screen display, which is not appropriate in terms of design.

There is another type of open/close detection means known in the field of mobile phone, which is composed of a magnetic sensor and a magnet and incorporated in a mobile phone having two units coupled through a two-axis coupling section (refer to Japanese Patent Application Publication No. 2003-174495). This type of detection means can be incorporated in convertible tablet/notebook computers.

The detection means disclosed in Japanese Patent Application Publication No. 2003-174495 is arranged in the following manner. One set of a magnetic sensor and a magnet is disposed close to the coupling section of the two units whereas another set of a magnetic sensor and a magnet is disposed away from the coupling section. If this structure is adopted by convertible tablet/notebook computers, a magnet sensor is arranged close to a position where the wrist of a user is rested. If the user wearing a magnetic bracelet uses the computer in this situation, the bracelet would cause false detection.

SUMMARY OF THE INVENTION

The present invention has been made in view of the above circumstances and provides an electronic apparatus having a detection means that detects the posture in notebook PC mode and the posture in tablet PC mode with high reliability.

According to the present invention, an electronic apparatus is provided with a first unit having a keyboard and a second unit having a display screen, the second unit being coupled to the first unit through a coupling section having two axes by

which the second unit is opened, closed, and rotated relative to the first unit, the electronic apparatus comprising:

a first sensor and a second sensor that are disposed on the first unit such that the sensors are positioned closer to the coupling section between the keyboard and the coupling section; and

a first member and a second member that are disposed on the second unit, the first member coming near and affecting the first sensor when the electronic apparatus is in a first closed status in which the second unit is closed to lie on the first unit with the display screen facing the first unit, and the second member coming near and affecting the second sensor when the electronic apparatus is in a second closed status in which the second unit is closed to lie on the first unit with the back of the display screen facing the first unit.

As described above, the sensors and the members are disposed closer to the coupling section away from the keyboard and the display screen respectively, in the apparatus of the present invention. Thus, false detection can be avoided. Also, the apparatus of the present invention does not need to detect the rotation of the display screen (second unit) and only detects the opened/closed status of the display unit. Thus, the orientation of the images displayed on the display screen is not turned even when the display screen is rotated during the use as a notebook PC.

In the electronic apparatus of the present invention, the first sensor and the second sensor may be both disposed on one side of a rotation axis that allows the second unit to be rotated relative to the first unit, the rotation axis being one of the two axes of the coupling section, and the first member and the second member may be disposed such that the rotation axis is interposed therebetween.

With this arrangement, the first closed status and the second closed status can be precisely discriminated and detected.

Further, in the electronic apparatus of the present invention, the first sensor and the second sensor may be both disposed closer to a surface on which the keyboard is placed in the thickness of the first unit;

the first member may be disposed closer to a surface on which the display screen is placed in the thickness of the second unit; and

the second member may be disposed closer to the reverse of the surface on which the display screen is placed in the thickness of the second unit.

When the sensors and members are thus arranged within thickness of the first and second units, the opened/closed status can be more precisely detected and the false detection can be more surely prevented.

Furthermore, in the electronic apparatus of the present invention, the first sensor and the second sensor may be disposed on the same circuit substrate.

This makes it easy to adjust the relative positions of the two sensors in assembling and lower the cost because only one circuit substrate is used.

Still furthermore, in the electronic apparatus of the present invention, the first sensor and the second sensor may be magnetic sensors, and the first member and the second member may be magnets.

According to the present invention as described above, the opened/closed status can be detected with high reliability even when the apparatus can be closed in two different manners.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective illustration of an electronic apparatus according to an embodiment of the present invention;

FIG. 2 is a perspective illustration of the electronic apparatus shown in FIG. 1 in which the optical disk drive is in the open status;

FIG. 3 is a perspective illustration of a port replicator attached to the electronic apparatus shown in FIGS. 1 and 2;

FIG. 4 is a perspective illustration of the electronic apparatus of the present invention in the open status, coupled to the port replicator shown in FIG. 3;

FIG. 5 is a perspective illustration showing the electronic apparatus of the present invention in the closed status, coupled to the port replicator;

FIG. 6 is a perspective illustration showing the second unit rotated by 90° relative to the normal open position;

FIG. 7 is a perspective illustration showing the second unit lying on the first unit with the display screen facing upward;

FIG. 8 is a plan view showing an engagement unit provided in the first unit;

FIGS. 9A and 9B are perspective views of an attachment unit provided in the second unit;

FIGS. 10A and 10B are perspective views of a fixture member of the attachment unit.

FIGS. 11A and 11B show a cutaway view of a cover member of the attachment unit;

FIGS. 12A and 12B are perspective illustrations of another embodiment of an attachment unit;

FIGS. 13A and 13B show a fixture member of the attachment unit of FIGS. 12A and 12B;

FIGS. 14A and 14B show a cutaway view of a cover member of the attachment unit of FIGS. 12A and 12B;

FIG. 15 is an exploded view showing the procedure of assembling the attachment unit;

FIG. 16 is an enlarged view of the vicinity of the coupling section of the electronic apparatus shown in FIG. 1;

FIG. 17 shows the status in which the second unit is rotated by 180° to allow the back of the second unit to face the keyboard switched from the status shown in FIG. 16;

FIGS. 18A, B and C show views in which the second unit is opened by 180° relative to the first unit;

FIG. 19 shows the upper right portion of the back cover and the display panel of the second unit of the electronic apparatus shown in FIG. 1;

FIG. 20 shows the same portion as FIG. 19, and shows the antenna and the fixing part in the normal positions;

FIG. 21 shows the same portion as FIGS. 19 and 20 and the antenna, the fixing part, and the display panel are arranged in the normal positions;

FIG. 22 shows the structure of the lower left portion of the display panel;

FIG. 23 shows the structure of the lower left portion of the display panel;

FIG. 24 shows the structure of the lower left portion of the display panel;

FIG. 25 shows the structure of the lower left portion of the display panel;

FIG. 26 shows a part of a bottom cover of the first unit of the electronic apparatus shown in FIG. 1, and a circuit substrate arranged on the bottom cover;

FIG. 27 is a block diagram of the DC-DC converter;

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FIG. 28 shows the relative positions of the bottom cover and the external coil viewed from the bottom cover;

FIG. 29 is a block diagram of a system for controlling the optical disk drive of the electronic apparatus shown in FIG. 1;

FIG. 30 is a flowchart of a program operating in the CPU of the main system to control the optical disk drive of the electronic apparatus;

FIG. 31 shows a screen display for enabling the user to control use of the optical disk drive;

FIG. 32 shows a screen display when the optical disk drive is disabled;

FIGS. 33A and 33B are further screen displays showing that the optical disk drive is disabled;

FIGS. 34A and 34B show examples of screen displays for enabling use of the optical disk drive;

FIG. 35 shows an example of the screen displayed when use of the optical disk drive is enabled in response to the query displayed in FIG. 34B;

FIG. 36 shows an example of the screen displayed informing that the optical disk drive 26 is enabled; and

FIG. 37 shows the warning screen when the function of prohibiting the use of optical disk drive is overridden in the tablet mode.

DETAILED DESCRIPTION OF THE INVENTION

An embodiment of an electronic apparatus according to the present invention is explained below.

[Appearance]

FIG. 1 is a perspective illustration of the appearance of the electronic apparatus of the present invention.

An electronic apparatus 10 includes a first unit 20, and a second unit 30. These first unit 20 and second unit 30 are coupled through a two-axis coupling section 40 such that the second unit 30 can be opened and closed in the direction of the arrow A-A to the first unit 20, and can be rotated in the direction of the arrow B-B (on the vertical rotation axis). In FIG. 1, the second unit 30 is open relative to the first unit 20 (open status).

The first unit 20 includes on an upper cover 73 a keyboard 21, a track pad 22, a left click button 23, a right click button 24, and an engagement unit 25 for engaging the second unit 30 when the second unit 30 is closed. The engagement unit 25 is provided with an engagement hole 251 for the fixture of the second unit 30, and an engagement release button 252 for releasing the engagement of the fixture in the engagement hole. The details of the engagement unit 25 are described later. On a side of the first unit 20, an open/close cover 261 of an optical disk drive 26 for accessing an optical disk such as a CD, a DVD, etc. The open/close cover 261 is provided with an eject button 262 for opening the open/close cover 261 so that the disk can be inserted or removed from the optical disk drive 26.

FIG. 2 is a perspective illustration of the electronic apparatus of FIG. 1 showing the optical disk drive 26 in the open position.

When the eject button 262 provided on the open/close cover 261 of the optical disk drive 26 is pressed, the tray of the optical disk drive 26 can be projected as shown in FIG. 2, so that the optical disk can be inserted or removed.

Referring back to FIG. 1, the second unit 30 of the electronic apparatus 10 shown in FIG. 1 includes a front cover 63 having a display window 631. This side of the second unit 30 will be referred to as the "front" side. In the display window 631, a display screen 611 of a built-in display panel 61 (refer, e.g., to FIGS. 19 to 21) is shown. The combination of the display screen 611 and the display window 631 is sometimes

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referred to as display screen 31. The second unit 30 is provided with buttons 32 adjacent to the display screen 31. Above the display screen 31 is an attachment unit 33 provided with a fixture for engaging the engagement unit 25 of the first unit 20 when the second unit 30 is closed. As described in detail later, the attachment unit 33 includes two fixtures. In FIG. 1, one fixture 332a of the two fixtures is projected from an aperture 331a on the front of the second unit 30.

FIG. 3 is a perspective view of a port replicator 50 for use with the electronic apparatus 10 shown in FIG. 2. FIG. 4 shows the first unit 20 of the electronic apparatus 10 coupled to the port replicator 50 with the second unit 30 in the open position.

As shown in FIG. 3, the port replicator 50 is provided with a connector 51 for electrically coupling to the first unit 20, and has a variety of I/O terminals on the back (not shown). The connector 51 of the port replicator 50 is coupled to a mating connector (not shown) provided at the bottom of the first unit 20, thereby providing a signal between the first unit 20 and the port replicator 50. Although various I/O terminals are provided in the first unit 20, the port replicator 50 has the function of extending the number of the I/O terminals. Various peripheral devices may be connected to the I/O terminals of the port replicator 50, thereby adding the functionality of the electronic apparatus 10. Thus, the first unit is simply placed on the port replicator 50 as shown in FIG. 4 to provide the desired added functionality. However, when it is not necessary to use the peripheral devices provided by the port replicator 50, the electronic apparatus 10 may be removed from the port replicator 50 and can be used as either in the notebook PC mode or the tablet PC mode.

FIG. 5 shows the electronic apparatus 10 placed on the port replicator with the second unit 30 in the closed position.

The second unit 30 is laid on the first unit 20 with the display screen 31 (refer to FIG. 1) facing the first unit 20, which is referred to as the first closed status.

As shown in FIG. 5, the attachment unit 33 for engagement in the first unit 20 in the closed status has an aperture 331b on the back of the second unit 30. The details of the attachment unit 33 are described later.

FIG. 6 shows the electronic apparatus 10 with the second unit 30 is rotated by 90° relative to the front side of the first unit 20. The second unit 30 can be further rotated such that the display screen 31 faces away from the keyboard 21.

The second unit 30 can then be rotated down into a position such that the display screen 31 faces upward when the two units are closed, as shown in FIG. 7. In this position, the display is opposite the keyboard 21 and is visible to the user. This position is referred to as the second closed status. In the second closed status, the electronic apparatus 10 may be used as a tablet PC, and this is sometimes referred to herein as the tablet mode. Normally, in the tablet mode, the electronic apparatus 10 is not coupled to the port replicator 50 (refer to FIG. 3).

The display screen 31 has a pen input function for detecting the contact of a pen or the close position of a pen. Normally, when the electronic apparatus 10 is in the tablet mode it is carried in the user's arm, and the hand of the other arm holds a pen (not shown), which is used to provide input directly to the display screen. Normally, in the tablet mode the image on the display screen 31 is rotated by 90° relative to the display provided in the notebook PC mode shown in FIG. 1.

When the electronic apparatus 10 is in the tablet mode as shown in FIG. 7, the aperture 331a of the attachment unit 33 on the second unit 30 faces upward. The aperture 331a is positioned adjacent to the display screen 31, and the aperture 331a is also shown in FIG. 1. As shown in FIG. 1, when the

electronic apparatus **10** is in the notebook mode, the first fixture **332a** projects from the aperture **331a**. In contrast, when the electronic apparatus **10** is in the tablet mode, no fixture projects from the aperture **331a** as shown in FIG. 7, instead, another fixture projects from the aperture **331b** (refer to FIG. 5) on the back of the second unit **30**, and the fixture is engaged in the engagement hole **251** shown in FIG. 1. In the engaged status the second unit **30** is securely held by the first unit **20** until the engagement release button **252** is operated. When the second unit **30** is engaged in the manner shown in FIG. 7, the electronic apparatus **10** can be used as a tablet PC having a planar housing.

[Engagement Unit and Attachment Unit]

FIG. 8 shows an embodiment of the engagement unit **25** provided in the first unit (refer to FIG. 1).

The engagement hole **251** is formed in the engagement unit **25**. At the center of the engagement hole **251**, an engagement detent **253** is extended from a side into the engagement hole **251**. Adjacent to the engagement hole **251**, the engagement release button **252** is formed on the side opposite to the detent. The engagement release button **252** and the engagement detent **253** are integrally formed as one piece (hereinafter referred to as an engagement part). At the center of the part, the engagement hole **251** is formed. The engagement part is slidably held in a frame part **254**, and the engagement part is urged by a spring **255** towards the direction of the release button **252**.

The top surface of the engagement detent **253** is tapered. When a fixture such as fixture **332a** or fixture **332b** (shown, for example in FIGS. 9A and 9B) of the attachment unit **33** enters the engagement hole **251**, the fixture exerts force on the tapered portion of the engagement detent **253**, causing the spring **255** to compress such that the engagement part slides out of the way of the fixture. As shown in FIGS. 9A and 9B, the fixtures have an aperture or hole formed therein which is sufficiently large to accept the engagement detent **253**. As the fixture travels into the engagement hole **251**, the hole in the fixture becomes aligned with engagement detent. This allows the spring **251** to release causing the detent **253** to enter the hole in the fixture and securely engage the engagement detent **253**. The fixture is thereby locked in position by the engagement unit **25**. When the engagement release button **252** is pressed, the engagement part compresses the spring **255** and moves the detent **253** out of the hole in the fixture. The fixture may then be removed from the engagement hole **251**.

FIGS. 9A and 9B show the attachment unit **33** provided in the second unit **30**, including a fixture. FIGS. 10A and 10B show a fixture member of the attachment unit **33** shown in FIGS. 9A and 9B. FIGS. 11A and 11b show a cover member of the attachment unit **33**.

The attachment unit **33** is composed of a fixture member **332** and a cover member **333**. First, the fixture member **332** is explained below.

FIGS. 10A and 10B respectively show the two sides of the fixture member **332** which are substantially identical.

The fixture member **332** is provided with the first fixture **332a** and the second fixture **332b** which are 90° apart. Between the fixtures is a projection **332c** which serves as a rotation axis. Two substantially identical concave sections **332d** and **332e** are formed at an equal distance from the projection **332c**. The concave sections **332d** and **332e** are connected by an arcuate groove **332f** which is shallower than the two concave sections **332d** and **332e**.

Now the cover member **333** is explained below.

FIG. 11a shows a cutaway view of the cover member. FIG. 11B shows the inner side of the cover member of the cut off portion.

The cover member **333** has two spaced apart, parallel plate sections **333a** and **333b**. Each of the plate sections **333a** and **333b** contains a support hole **333c** to engage the projection **332c** of the fixture member **332** such that the fixture member **332** can be rotated within the cover. A convex section **333d** is formed on interior of the two plate sections **333a** and **333b**. When the fixture member **332** is positioned in the cover member **333**, the convex section **333d** engages either the first concave section **332d** or the second concave section **332e**, or during the rotation of the fixture member **332**, the convex section **333d** is located within the arcuate groove **332f**. On both ends of the cover member **333**, a tip section **333g** having an attachment hole is provided.

The fixture member **332** is positioned within the cover member **333**, by inserting it between the two plate sections **333a** and **333b** of the cover member **333**. The two plate sections **333a** and **333b** expand allowing the fixture member **332** to enter the space between the two plate sections **333a** and **333b**, and the projection **332c** enters the support hole **333c**. Simultaneously, the convex section **333d** provided inside the two plate sections **333a** and **333b** is engaged in the first concave section **332d** or the second concave section **332e** of the fixture member **332**. The fixture member **332** can be rotated by 90°. During rotation, the convex section **333d** of the cover member **333** travels in the arcuate groove **332f**. Since the arcuate groove **332f** is shallower than the first concave section **332d** or the second concave section **332e**, the two plate sections **333a** and **333b** are deflected slightly outward during the rotation. The user can feel the fixture member “click” into position when the convex section **333d** enters the first concave section **332d** or the second concave section **332e**. Since the concave sections are deeper than the arcuate groove **332f**, the cover member **333** holds the fixture member **332** in position when the convex section **333d** is engaged in either first concave section **332d**, **332e**. Thus, in order to rotate the fixture member **332** it is necessary to apply a slight force.

The two apertures **331a** and **331b** shown in FIGS. 9A, 9B, 12A and 12B are formed on the sides of the cover member **333** by the plate sections **333a** and **333b**.

By rotating the fixture member **332** as previously described, either the first fixture **332a** or second fixture **332b** will extend from the aperture **331a** or **331b** as shown. The other fixture that does not project outwardly is retained in the space between the two plate sections **333a** and **333b**.

When the first fixture **332a** is operated and rotated from the position of FIG. 9A, the convex sections **333d** shown in FIG. 11 are removed from the first concave section **332d** shown in FIG. 10 with the feeling of click, the convex section **333d** travels on the arcuate groove **332f**. After rotating 90° and the convex sections **333d** engage in the second concave section **332e** shown in FIGS. 10A and 10B and click into position. At this time, as depicted in FIG. 9B, the second fixture **332b** projects from the aperture **331b** and the first fixture **332a** is stored between the two plate sections **333a** and **333b**.

In order to allow the electronic apparatus **10** in the open status shown in FIG. 4 to enter the first closed status shown in FIG. 5, the fixture member is rotated such that the first fixture **332a** of the fixture member **332** of the attachment unit **33** projects from the aperture **331a** of the display screen **31** (refer to FIG. 4), and the second unit **30** is rotated onto the top of the first unit **20** such that the display screen **31** faces the first unit **20**. In this position, the first fixture **332a** extends into the engagement hole **251** of the engagement unit **25** provided in the first unit **20**, the first fixture **332a** is engaged in the engagement unit **25** as explained above by referring to FIG. 8. The

second unit **30** is held securely in position until it is released by the engagement release button **252**.

To use the electronic apparatus **10** shown in FIG. **1** in the second closed status (tablet PC mode) shown in FIG. **7**, the fixture is rotated such that the second fixture **332b** of the fixture member **332** of the attachment unit **33** projects from the aperture **331b** (refer to FIG. **5**) on the back of the second unit **30**. The second unit **30** is rotated such that the display screen **31** faces upward from the first unit **20**, and further rotated onto the top of the first unit **20** such that the back of the second unit **30** faces the first unit **20**. In this position, the second fixture **332b** extends into the engagement hole **251** of the engagement unit **25**, thereby securely fixing the apparatus in the tablet mode. Thus, the first unit **20** can be securely held by the fixture member **332** in either the first or second closed positions by rotation of the fixture member. Rotation of the fixture member can be performed by a simple manipulation of the user's fingers, thereby allowing use in either the notebook PC mode and the tablet mode using a single hand.

Described below is another embodiment of the attachment unit.

FIGS. **12A** and **12B** show opposing sides of another embodiment of an attachment unit of the present invention. FIGS. **13A** and **13B** show opposing sides of the fixture member forming the attachment unit. FIGS. **14A** and **14B** show a cover member of the attachment unit. FIG. **15** is an exploded view showing how the attachment unit is assembled.

In this embodiment, the components corresponding to those of the attachment unit explained by referring to FIGS. **9** to **11** are assigned the reference numerals assigned in FIGS. **9** to **11**, and the features different from the attachment unit shown in FIGS. **9** to **11** are mainly explained below.

FIGS. **12A** and **12B** show an attachment unit similar to the one shown in FIGS. **9A** and **9B**. To the extent the alternative embodiment is the same in function or design as described above, the applicable description is not repeated. However, FIGS. **12A** and **12B** show a difference in the head section **334a** of an axis member **334** (refer to FIG. **15**). The axis member **334** is described later.

On the fixture member **332**, a bearing hole **332g** for insertion of the axis member **334** (refer to FIG. **5**) is formed between the first fixture **332a** and the second fixture **332b**. On the side depicted by FIG. **13A**, a circular concave section **332h** in which a flat washer **335** (refer to FIG. **15**) is engaged is formed. On the side indicated by FIG. **13B**, two first concave sections **332d** and two second concave sections **332e** are formed around the bearing hole **332g**. These two first concave sections **332d** and two second concave sections **332e** are coupled by the arcuate groove **332f** shallower than the first concave section **332d** and the second concave section **332e**. The first concave section **332d** and the second concave section **332e** are formed in two units, and are formed only on one side of the fixture member **332**. Otherwise, they operate in a manner similar to that previously described.

FIGS. **14A** and **14B** show the cover member of the attachment unit in this alternative embodiment. For illustration purposes, FIG. **14A** shows a cutout in a plate section **333b**, and FIG. **14B** shows the inner side of the plate section **333b** which has been cutout.

In the alternative embodiment, there are two the convex sections **333d** in the plate section **333a** which engage either the first concave section **332d** or the second concave section **332e** (see FIG. **13**). Grooves **333k** are formed adjacent to both sides of the support hole **333c** inside the other plate section **333b** to moderate the spring effect of a wavy washer **336**

(refer to FIG. **15**) by slightly deforming the part sandwiched between the grooves **333k** when the fixture member **332** is rotated.

When assembling the attachment unit, the fixture member **332**, the flat washer **335**, and the wavy washer **336**, which functions as a spring, are enclosed between the cover members **333** as shown in FIG. **15**. The fixture member **332** is arranged with the side shown in FIG. **13B** facing the plate section **333a**. The axis member **334** is then inserted through the components and the tip section **334b** of the axis member **334** is engaged in an E ring **337**. The E ring prevents the axis member **334** from slipping.

In this embodiment, the wavy washer **336** works as a spring, so that it is not necessary to depend on the spring force of the cover member **333**, thereby improving the flexibility in selection and design of materials.

[Open/Close Sensor]

When the electronic apparatus **10** is in the notebook PC mode shown in FIG. **1** and in the first closed status shown in FIG. **5** with the power turned on, the internal circuit in the apparatus causes it to enter "standby" status. On the other hand, when the electronic apparatus **10** is in the notebook PC mode shown in FIG. **1** and in the second closed status shown in FIG. **7**, such that it enters the tablet mode, the orientation of the image on the display screen **31** in the notebook PC mode is rotated by 90°. To realize these functions, the electronic apparatus **10** shown in FIG. **1** is provided with an open/close sensor for detecting whether the apparatus is opened or closed, as described below.

FIG. **16** is an enlarged view of the vicinity of the coupling section **40** of the electronic apparatus **10** shown in FIG. **1**.

FIG. **16** shows the electronic apparatus **10** in the first closed status with the display screen **31** facing the keyboard **21**, without a cover at the back portion of the keyboard **21** and the lower portion of the display screen.

A circuit substrate **28** is provided with a first magnetic sensor **271** and a second magnetic sensor **272** adjacent to the rotation axis **41**. In this structure, both the first magnetic sensor **271** and the second magnetic sensor **272** are positioned on a circuit substrate **28** to facilitate positioning of the sensors and, thereby, reducing the cost of manufacture.

The circuit substrate **28** is also provided with a connector **273** for transmission of a detected signal of the first magnetic sensor **271** and the second magnetic sensor **272** to computer circuitry. The connector **273** is combined with a connector **29** connected to the tip of the lead line from the circuit in the first unit first unit **20**. Signals from the first magnetic sensor **271** and the second magnetic sensor **272** are transmitted to the circuitry through the connectors **273** and **29**.

A first magnet **341** is arranged in the position below the display screen **31** of the second unit **30**, which is positioned over the first magnetic sensor **271** when the second unit **30** is closed in the first closed status, as shown in FIG. **5**. The first magnet **341** is in a case **341a** with an opening which allows it to provide a strong magnetic force in the direction of the display screen **31**.

By changing the electronic apparatus **10** from the open status shown in FIG. **1** to the first closed status shown in FIG. **5**, the first magnet **341** comes into position adjacent to the first magnetic sensor **271**. The first magnetic sensor **271** detects the magnetic force, and the first closed status is thereby detected.

A second magnet **342** is positioned on other side of the rotation axis **41**. The back of a case **342a** holding the second magnet **342** is shown in FIG. **16**. The case **342a** has an aperture (not shown) on the back of the display screen **31**, and the second magnet **342** is exposed from the aperture toward

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the back of the display screen. Therefore, the second magnet 342 has strong magnetic force away from the display screen.

In FIG. 16, a circuit substrate 35 is lifted out of the way to reveal the position of the second magnet 342. However, the circuit substrate 35 is arranged in a position in which the back of the case 342a storing the second magnet 342 is hidden.

FIG. 17 shows the second unit 30 (display screen 31) rotated by 180° to allow the back of the second unit 30 to face the keyboard 21.

As shown in FIG. 17, when the back of the second unit 30 faces the first unit 20, the second magnet 342 is moved to a position corresponding to the second magnetic sensor 272. The material of the back cover of the second unit 30 is selected to allow the magnetic force to pass without appreciable reduction in intensity, such that when the second unit 30 is laid on the first unit 20 with the back cover facing the first unit, the second magnet 342 is positioned adjacent to the second magnetic sensor 272, and the second closed status (tablet mode) can be detected.

FIGS. 18A-C shows the second unit 30 opened by 180° relative to the first unit 20. FIG. 18A is a left side view, FIG. 18B is a plan view, and FIG. 18C is a right side view.

In the present example, the thickness of the first unit 20 is 22 mm, and the first magnetic sensor 271 and the second magnetic sensor 272 are positioned 0.8 mm deeper than the surface of the keyboard of the first unit 20. The magnetic sensors 271 and 272 are each 2.2 mm thick. Thus, the first magnetic sensor 271 and the second magnetic sensor 272 are positioned close to the surface of the keyboard within the thickness of the first unit 20.

Also in the present example, the thickness of the second unit 30 is 12 mm, and the first magnet 341 is arranged at a depth of 2 mm from the surface of the display screen 31 of the second unit 30. The thickness of the first magnet 341 is 5 mm including the case 341a. Thus, the first magnet 341 is positioned close to the surface of the display screen 31 within the thickness of the second unit 30.

The second magnet 342 is positioned 0.8 mm from the back of the second unit 30, and the thickness of the second magnet 342 is 5 mm including the case 342a. Thus, the second magnet 342 is positioned closer to the back, within the thickness of, the second unit 30.

Therefore, in the first closed status, the first magnet 341 is close to the first magnetic sensor 271 and applies strong magnetic force to the first magnetic sensor 271. In the second closed status, the second magnet 342 is close to the second magnetic sensor 272, and applies strong magnetic force to the second magnetic sensor 272. Thus, according to the embodiment, when the electronic apparatus is closed in either the first or second closed status, a strong magnetic force is applied to one or the other of the magnetic sensors, with a high signal to noise ratio.

In this embodiment, the residual flux density B_r of the first magnet 341 and the second magnet 342 is $B_r=0.41$ to 0.43 (T). When the first closed status is entered, the first magnetic sensor 271 detects the magnetic force of the first magnet 341 when the space between the longest portions (near the engagement unit 25 and the attachment unit 33) from the coupling section 40 reaches 15 mm to 30 mm. When the second closed status is entered, the second magnetic sensor 272 detects the magnetic force of the second magnet 342 when the space reaches 20 mm to 40 mm.

The first magnetic sensor 271 and the second magnetic sensor 272 are placed on the side of the coupling section 40 beyond the keyboard 21. Therefore, the wrist of a user is unlikely to be placed near the magnetic sensor in the normal

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use. This minimizes the possibility that a user with a magnetic bracelet can cause a false detection signal.

[Display Panel Fixed Structure]

FIG. 19 shows the upper right portion of the back cover and the display panel of the second unit 30 of the electronic apparatus 10 shown in FIG. 1. In FIG. 19, an antenna 64 and a fixing part 65 indicate the status prior to the engagement in a back cover 62, and the display panel 61 is also not in final position.

FIG. 20 shows the same portion as FIG. 19, but the antenna 64 and the fixing part 65 in their normal assembled positions. FIG. 21 shows the same portion as FIGS. 19 and 20, with the antenna 64, the fixing part 65, and the display panel 61 all arranged in the normal positions.

The components of the second unit 30 (refer to FIG. 1), i.e., the display panel 61 having the display screen 611 and the back cover 62 covering the back of the display panel 61 are shown. The front side of the display panel 61 is covered with the front cover 63.

As shown in FIG. 19, the antenna 64 is fixed to the fixing part 65. The fixing part 65 is used in fixing the antenna 64, and is also used in fixing the display panel 61. In this embodiment, the method of fixing the display panel 61 using the fixing part 65 is mainly explained.

The display panel 61 has a mounting hole 612 for a screw. On the other hand, a boss 621 having a central screw hole 621a for fixing the display panel 61 is located on the back cover 62. The boss 621 is offset from the mounting hole 612 of the display panel 61. On the central axis of the mounting hole 612, used when the display panel 61 is in the normal position, a positioning pin 622 is located on the back cover 62. In addition, a projection 623 is provided on the back cover 62. Furthermore, a boss 624 having a central screw hole 624a, and a boss 625 having a central screw hole 625a are provided.

The fixing part 65 includes a mounting hole 651 and a positioning hole 652 to which the antenna 64 is fixed, and a boss 653 having a screw hole 653a penetrated at its center. The aperture (see FIG. 19) at the bottom of the screw hole 653a is used as a positioning hole for receiving and engaging the positioning pin 622 of the back cover 62. At its top, the screw hole 653a is used for attachment with the mounting hole 612 of the display panel 61 by screwing them together.

The fixing part 65 is arranged as shown in FIG. 20. The bottom of the screw hole 653a in the boss 653 is for receiving and engaging the positioning pin 622 (refer to FIG. 19). Thus, the mounting hole 651 of the fixing part 65 is arranged on the screw hole 621a at the center of the boss 621 provided for the back cover 62, and the projection 623 provided in the back cover 62 is engaged in the positioning hole 652 of the fixing part 65. The positioning hole 652 of the fixing part 65 is formed large for loose engagement of the projection 623 of the back cover 62, and the mounting hole 651 of the fixing part 65 is also formed large for the diameter of the central screw hole 621a of the boss 621 provided in the back cover 62. Correspondingly, the diameter of the screw hole 653a penetrated at the center of the boss 653 of the fixing part 65 matches the positioning pin 622 of the back cover 62 in dimension. Therefore, the screw hole 653a in the center of the boss 653 of the fixing part 65 is arranged in the correct position for the positioning pin 622 of the back cover 62.

As shown in FIG. 21, the mounting hole 612 (refer to FIG. 20) of the display panel 61 is placed and screwed into the screw hole 653a of the fixing part 65. At this time, the mounting hole 612 of the display panel 61, the screw hole 653a in the center of the boss 653 of the fixing part 65, and the positioning pin 622 of the back cover 62 are coaxial.

The boss 621 for fixing the display panel 61 is provided on the back cover 62 in the position off the mounting hole 612 of the display panel 61 as described above. However, the positioning pin 622 is set on the same central axis as the mounting hole 612 of the display panel 61 when the display panel 61 is arranged in the normal position on the back cover 62, and the positioning pin 622 is engaged in the positioning hole (aperture at the bottom of the screw hole 653a in the center of the boss 653) of the fixing part 65, and the mounting hole 612 of the display panel 61 is screwed to the screw hole (aperture at the upper portion of the screw hole 653a in the center of the boss 653) coaxial with the positioning hole (aperture at the bottom portion), thereby fixing the display panel 61 in the normal position with high precision.

In the embodiment described above, only one type of the display panel 61 is shown, but another type of display panel having a different mounting hole position can be incorporated into the back cover having the same structure. The other type of display panel is directly screwed into the screw hole 624a when a mounting hole is positioned in the same central axis as the screw hole 624a in the center of the boss 624 (refer to FIG. 19) and the display panel is incorporated.

If a boss for screwing the display panel 61 of the type shown in FIG. 19 is located in the position of the positioning pin 622 of the back cover 62, then the boss would interfere with the display panel of the type which directly screws into the screw hole 624a. Therefore, such a display panel cannot be incorporated. Therefore, in the illustrated embodiment, the positioning pin 622 is set in the position corresponding to the mounting hole 612 of the display panel 61, and the screw hole 621a for fixing the display panel 61 to the back cover 62 is provided in the boss 621 arranged in a different position, and the connections are made by the fixing part 65. In connecting the fixing part 65, the screw hole 653a in the boss 653 of the fixing part 65 is registered with the positioning pin 622 of the back cover 62 as described above, and attachment can be made with almost the same high position precision as the configuration of directly screwing into the central screw hole provided to the back cover 62.

When a display panel of the type which directly screws into the central screw hole 624a of the boss 624 is incorporated into the central screw hole 624a, the boss 653 or a metal fixture having no planar portion for fixture of the boss 653 is used instead of the fixing part 65 with the structure shown in FIG. 19. This is because the display panel of the type which directly screws into the central screw hole of the boss 624 interferes when a boss is set in the position of the positioning pin 622 of the back cover 62, and the spread of the fixing part as describe above interferes with the incorporation of the display panel.

Another boss 625 shown in FIGS. 19 to 21 is used in fixing the front cover 63 (refer to FIG. 1).

FIGS. 19 to 21 show the fixed structure of the upper right portion of a display panel. The structure at the upper left portion of the display panel is almost the same as the structure at the upper right portion, except there is no antenna, and therefore, need not be further described.

FIGS. 22 to 25 show the fixed structure of the lower left portion of the display panel.

FIG. 22 shows the back cover; FIG. 23 shows the display panel attached to the back cover; FIG. 24 shows another type of fixing part for fixing another type of display panel; and FIG. 25 shows another type display panel different from the display panel shown in FIG. 23, attached using the fixing part shown in FIG. 24.

As shown in FIG. 23, the back cover 62 is provided with a boss 626 having a central screw hole for screwing a fixing part

66, and is also provided with two positioning pins 627 and 628. The back cover 62 is also provided with other boss 629 having a central screw hole 629a and projection 630. They are used for attaching other parts as described later, and are not related to mounting the display panel.

The positioning pin 627 is used to fix a display panel including a mounting hole positioned on the same central axis as the positioning pin 627. The positioning pin 628 is used to fix a display panel in which a mounting hole is arranged on the same central axis as the positioning pin 628.

The fixing part 66 shown in FIG. 22 has a mounting hole which has already accepted a screw and, therefore the mounting hole is hidden from view. A positioning hole 661 is engaged with the positioning pin 627. The part 66 includes a screw hole 662 to which the mounting hole of the display panel is screwed. A fixing part 66 has a bent portion 66a having two plates bent to face each other, with the positioning hole 661 formed on the lower plate, and the screw hole 662 is formed in the upper plate. The screw hole 662 is on the same central axis as the positioning hole 661. In the fixing part 66, the diameter of the positioning hole 661 matches the diameter of the positioning pin 627, and the screw hole 662 can be positioned with high position precision.

FIG. 23 shows the display panel 61 in which the mounting hole is screwed to the screw hole 662 of the fixing part 66 shown in FIG. 22, and the mounting hole (already screwed, and hidden below the screw) of the display panel 61, the screw hole 662 of the fixing part 66 shown in FIG. 22, the positioning hole 661, and the positioning pin 627 of the back cover 62 are all on the same central axis, thereby screwing the display panel 61 with high position precision.

As shown in FIG. 23, other parts are arranged on another boss 629 provided on the back cover 62 and the projection 630 (refer to FIG. 22), and the front cover 63 (refer to FIG. 1) is further arranged on them. The front cover 63 is screwed to the screw hole 629a of the boss 629 with the other parts.

The fixing part 67 shown in FIG. 24 is a fixing part for fixing another type of display panel. As with the fixing part 66 shown in FIG. 22, a mounting hole (as in the case shown in FIG. 22, it is already screwed, and the mounting hole is hidden below the screw) screwed into the central screw hole (not shown) of the boss 626 of the back cover 62 is provided. The fixing part 67 shown in FIG. 24 includes a cutout 671 into which the positioning pin 627 is engaged to position the fixing part 67. Furthermore, the fixing part 67 is provided with a boss 672 having a central screw hole 672a. The aperture of the bottom portion of the screw hole 672a of the boss 672 is used as a positioning hole in which the positioning pin 628 (refer to FIG. 22) provided in the back cover 62 is engaged. The aperture at the upper portion shown in FIG. 24 of the screw hole 672a is used as a screw hole for screwing the mounting hole of a display panel.

FIG. 25 shows a display panel 61' in which a mounting hole is screwed to the screw hole of the boss 672 of the fixing part 67 shown in FIG. 24. The mounting hole (already screwed and is hidden below the screw) of the display panel 61', the screw hole 672a of the boss 672 of the fixing part 67 shown in FIG. 24, and the positioning pin 628 of the back cover 62 are all on the same central axis, and the display panel 61' is fixed with high position precision.

No boss is provided in the positions of the two positioning pins 627 and 628 of the back cover 62 shown in FIG. 22 for the same reason as there is no boss in the position of the positioning pin 622 shown in FIG. 19. If a boss is set in the position of the positioning pin 627 shown in FIG. 22, it would interfere with the display panel 61' such that the display panel 61' could not be incorporated. Likewise, if a boss is set in the

position of the positioning pin **628** shown in FIG. **22**, it would interfere with the display panel **61** shown in FIG. **23**, such that the display panel **61** could not be incorporated. In this embodiment, the positioning pins **627** and **628** are provided on the same central axis as the mounting hole of the display panel, and either the positioning pin **627** is engaged in the positioning hole **661** of the fixing part **66** shown in FIG. **22**, or the positioning pin **628** is engaged at the bottom of the screw hole **672a** of the boss **672** of the fixing part **67**, as shown in FIG. **24**. Therefore, either of the display panels **61** and **61'** can be mounted with high position precision although a boss is set in a position different from the position of the mounting hole of the display panel.

[Arrangement of External Coil]

FIG. **26** shows a part of a bottom cover **71** of the first unit **20** of the electronic apparatus **10** shown in FIG. **1**, and a circuit substrate **72** arranged on the bottom cover.

The first unit **20** of the electronic apparatus **10** shown in FIG. **1** includes the bottom cover **71** shown in FIG. **26**, the circuit substrate **72** arranged on the bottom cover **71** and other parts not shown in the attached drawings, and the upper cover **73** (refer to FIG. **1**) including the keyboard **21** (refer to FIG. **1**), etc.

As shown in FIG. **26**, the bottom cover **71** is provided with some apertures **711a**, **711b**, and **711c** and air holes **721a**, **721b**, and **721c** for circulation of air.

The circuit substrate **72** includes various circuits, and is, for example illustrated here, four DC-DC converters. FIG. **26** shows a total of five external coils **721** for four DC-DC converters together with many other circuit units.

FIG. **26** shows the inner side of the bottom cover **71**, and the side of the bottom cover of the circuit substrate **72**. This circuit substrate **72** is arranged on the bottom cover **71** such that the face shown in FIG. **26** faces the bottom cover **71** as indicated by arrow in FIG. **26**.

FIG. **27** is a rough block diagram of the DC-DC converter.

Power supply of input voltage V_{in} of 19V is applied when the electronic apparatus **10** is connected to an AC power supply, or power supply of the voltage of 10.8V is applied when a battery (not shown) is used. In either case, the power supply voltage is input to a gate circuit **722**. The gate circuit **722** turns the input power on and off at the frequency of, for example, about 250 to 400 kHz under the control of an external coil **721**, uses an external coil **721** to generate predetermined DC voltage V_{out} . In the case of a DC-DC converter requiring large electric power, the gate circuits **722** and the external coils **721** are connected in parallel. The DC-DC converter itself is a well known technique, and no further explanation about the DC-DC converter is required.

As described above, the display panel **61** (refer to FIGS. **19** to **21**) has a pen inputting function, and communicates with the pen at a high frequency. Thus, it is susceptible to interference from external rf. Specifically, rf in the range of 270 kHz to 300 kHz, may cause interference with pen operation. Since the DC-DC converter operates in this general frequency range, the external coil **721** functions as an antenna to generate rf noise that potentially could interfere with the open operation.

When the electronic apparatus **10** is operated in the notebook PC mode, the second unit **30** (display screen **31**) is open and, therefore, separated from the circuit substrate of the first unit **20**. Thus, rf from the coils in the first unit is unlikely to interfere with the display screen **31**. In the tablet mode, although the two units are in contact, rf from the coils in the first unit is also unlikely to interfere with the display screen **31** because the circuit substrate in the first unit **20** is positioned on the back of the display screen **31** and thus any rf from the

circuit substrate in the first unit **20** must penetrate the base unit to reach the display screen **31**. However, in the first closed status, with the display screen **31** lying on directly on the first unit, a keyboard and display monitor can be externally connected such that the electronic apparatus may be operated in this mode. When used in this manner, there is nothing to shield the rf from the circuit substrate from reaching the display screen **31**.

In this situation, as shown in FIG. **26**, the external coil **721** of the DC-DC converter is loaded on the side facing the bottom cover **71** of the circuit substrate **72**. The external coil **721** generates strong noise on the side loaded with the external coil **721**, but the noise transmitted to the reverse side of the surface loaded with the external coil **721** on the circuit substrate **72** is substantially attenuated. In this embodiment, the external coil **721** of the DC-DC converter is loaded on the surface facing the bottom cover **71** of the circuit substrate **72**. Therefore, although the electronic apparatus is used in the closed status as shown in FIG. **5**, interference due to rf noise from the external coil **721** can be prevented.

In this embodiment, all the five external coils **721** are loaded onto the surface facing the bottom cover **71** of the circuit substrate **72**. However, when the frequency used in the DC-DC converter is substantially different from the 270 kHz to 300 kHz which is the frequency of easily causing a malfunction of the display panel **61**, it is not necessary to position all or some of the coils on the surface facing the bottom cover **71** of the circuit substrate **72**. In this embodiment, two of the five external coils **721** are those used in the DC-DC converter operating around 350 kHz and 400 kHz, and these two the external coils may not be positioned on the surface facing the bottom cover **71** of the circuit substrate **72**, that is, can be arranged on the keyboard **21** side (refer to FIG. **1**) of the circuit substrate **72**.

FIG. **28** shows the relative positions of the bottom cover and the external coils viewed from the bottom cover.

The five external coils **721** on the circuit substrate **72** are arranged as surrounding the air hole **712a** of the bottom cover **71** because the DC-DC converter processes electric power and thus the external coil **721** generates heat. When a heat generating external coil **721** is aligned with the air holes in an array **712a**, the flow of air is hindered and the heat dissipation is degraded. Therefore, the five external coils **721** are preferably arranged to surround the air holes **712a**, not immediately below (above) the air hole **712a**, such that the flow of air is not impeded and necessary cooling can be performed.

[Protection of the Optical Disk]

FIG. **29** is a block diagram showing the control of the optical disk drive **26** (refer to FIGS. **1** and **2**) of the electronic apparatus **10** shown in FIG. **10**.

FIG. **29** shows: a main system **81** provided with a control unit having a CPU, memory, etc.; a display section **82** for displaying an image described later on the display screen **31** shown in FIG. **1**, in response to an instruction of the main system **81**; a open/close detection section **83** for discriminating the open status (refer to FIG. **1**), the first closed status (refer to FIG. **5**), and the second closed status (refer to FIG. **7**) using the magnetic sensors **271** and **272**, and the magnets **341** and **342** (refer to FIG. **16**), and transmitting them to the main system **81**; a port replicator connection detecting section **84** for detecting the attachment of the first unit **20** to the port replicator **50** shown in FIG. **3** and transmitting the information to the main system **81**; and the optical disk drive **26** operating under the control of the main system **81**. The port replicator connection detecting section **84** detects the connection/disconnection between the connector **51** provided in the port replicator **50** shown in FIG. **3** and the connector (not

shown) for coupling with the connector **51** and provided at the bottom of the first unit **20** by detecting the electrical disconnection of one pin.

As shown in FIG. **29**, the optical disk drive **26** includes a drive control section **91** for control of the entire optical disk drive; a motor **92** for rotating and stopping an optical disk such as an inserted CD, DVD, etc. under the control of the drive control section **91**; as shown in FIG. **1** and FIG. **2**, the eject button **262** for issuing an instruction to open, as shown in FIG. **2**, the optical disk drive in the status shown in FIG. **1**; and an ejection mechanism **93** for projecting the tray of the optical disk drive **26** outward as shown in FIG. **2** under the control of the drive control section **91**. In the electronic apparatus shown in FIG. **1**, a drive of a tray loading system is adopted as an optical disk drive, but it is obvious that a drive of any other systems using no tray can be applied to the present invention. The present invention can also be applied to a drive for any other storage media such as, in addition to an optical disk, a floppy disk, MO, etc.

In the main system **81**, according to the detection results of the open/close detection section **83** and the port replicator connection detecting section **84**, it is determined whether or not the electronic apparatus **10** is in the tablet mode as shown in FIG. **7**.

In this embodiment, if the port replicator connection detecting section **84** detects that the status is changed from the status in which the electronic apparatus **10** is connected to the port replicator **50** as shown in FIGS. **4** and **5** to the status in which it is disconnected from the port replicator **50** as shown in FIG. **1**, and if the open/close detection section **83** detects the second closed status as shown in FIG. **7**, then it is determined that the tablet mode is entered. If the open/close detection section **83** does not detect the second closed status as shown in FIG. **7** or the port replicator connection detecting section **84** detects the connection to the port replicator **50** as shown in FIG. **3**, then it is determined that the tablet mode is terminated. For more security relating to the control of the optical disk drive **26**, it is determined that the tablet mode is entered by the detection of the port replicator connection detecting section **84** about the disconnection from the port replicator or the detection of the open/close detection section **83** about the second closed status as shown in FIG. **7** in controlling the optical disk drive **26**.

When the main system **81** determines that the tablet mode is entered or the tablet mode is terminated, the determination result is transmitted to the drive control section **91** of the optical disk drive **26**. Upon receipt of the information from the main system **81** that the tablet mode is entered, the drive control section **91** stops the rotation of the motor **92** if it is working, prohibits the rotation, and prohibits the opening operation of the optical disk drive by the ejection mechanism **93** as shown in FIG. **2** even if the eject button **262** is pressed.

When a notification that the tablet mode is terminated is received from the main system **81**, the drive control section **91** rotates the motor **92** at the access request from the main system **81** to access an optical disk, or accepts the operation of the eject button **262** to instruct the ejection mechanism **93** to open the optical disk drive as shown in FIG. **2**.

The main system **81** also allows the display section **82** to display that the access to an optical disk is prohibited.

FIG. **30** is a rough flowchart of the program operating in the CPU of the main system when the detection result is changed.

The program operates when the open/close detection section **83** shown in FIG. **29** detects the opened/closed status or the port replicator connection detecting section **84** detects the attachment status of the port replicator **50**.

The program first determines whether or not the tablet mode is entered (step a). If the tablet mode is entered, the notification that the tablet mode is entered is issued, that is, an instruction to disable the rotation drive of an optical disk by the motor **92** (step b1) and to disable ejection (step b2) is issued, and an instruction to display the information that the optical disk drive **26** is inoperable (step b3) is issued.

If it is determined in step a that the tablet mode is not entered, the notification that the tablet mode is not entered is issued, that is, an instruction to release the prohibition of the drive of an optical disk by the motor **92** (step c1) and to release the prohibition of ejection (step c2) is issued, and an instruction to erase the information that the optical disk drive **26** is inoperable (step c3) is issued.

Described below are various screens displayed when the use of the optical disk drive **26** is prohibited and when the prohibition is released.

FIG. **31** shows the setting screen on which whether or not the function of prohibiting the use of the optical disk drive **26** and the function of releasing the prohibition is used.

In this embodiment, the function according to the flow shown in FIG. **30** can be used by checking the column of "Lock CD/DVD drive when the unit is in tablet mode", and then pressing the "OK" button.

FIG. **32** shows an example of the screen displayed when the optical disk drive transfers to the use disabled status.

In this embodiment, an icon indicating that the optical disk drive is in the use disabled status is displayed, and the indication of having entered the use disabled status is displayed for a certain period of time. FIG. **33** shows an example of the screen displaying that the optical disk drive is currently in the use disabled status.

Part (A) of FIG. **33** shows an icon indicating that the optical disk drive is currently in the use disabled status. When the icon is pointed to by the cursor on the display screen, the explanation of the icon is displayed for a predetermined time as indicated by part (B) of FIG. **33**.

FIG. **34** shows an example of the screen when the prohibition of use of the optical disk drive is forcibly released.

Part (A) of FIG. **34** shows the screen displayed when the icon indicating that the optical disk drive is in the use disabled status is clicked. Part (B) of FIG. **34** shows the screen when "Unlock the CD/DVD Drive for the tablet session" is clicked.

Clicking "Unlock the CD/DVD Drive for the tablet session" is performed by a user operation to enable the optical disk drive **26** even in the tablet mode.

FIG. **35** shows, as indicated by part (B) of FIG. **34**, an example of the screen when "Unlock the CD/DVD Drive for the tablet session" is clicked.

The screen is to confirm the availability of the optical disk drive **26**. If "YES" is clicked on the screen, the optical disk drive **26** becomes available.

FIG. **36** shows an example of the screen informing that the prohibition of use of the optical disk drive **26** is forcibly released.

If "YES" is clicked on the screen in FIG. **35**, the prohibition of the use of the optical disk drive **26** is forcibly released, and the optical disk drive **26** becomes available. The user is notified of the availability of the optical disk drive **26** by the display for a predetermined time on the screen shown in FIG. **36**.

FIG. **37** shows on the setting screen shown in FIG. **31** the function of following the flow shown in FIG. **30** by removing the check of "Lock the CD/DVD drive when the unit is in tablet mode", that is, the warning screen when the function of prohibiting the use of optical disk drive **26** is nullified in the tablet mode.

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Clicking the "OK" button on the warning screen, the present function can be nullified.

The posture to be taken when an optical disk is rotatably driven is prescribed on the optical disk drive. There is the possibility that access cannot be correctly gained if the drive cannot be started in a correct posture. In this case, an optical disk and an optical disk drive can be damaged.

In this embodiment, the motor drive (drive of an optical disk) by an optical disk drive is prohibited when the tablet mode is entered. Therefore, although an optical disk is loaded on the optical disk drive, damage can be avoided. Additionally, in the tablet mode, the side of the eject button **262** (refer to FIG. **1**) can touch the waist of the user and the electronic apparatus **10** is used as carried by the arm. However, in the tablet mode, the operation of the eject button is nullified. Therefore, accidentally opening the optical disk drive, dropping the optical disk inserted in the apparatus, and being seriously damaged can be prevented.

The control according to the functions of the present embodiment can also be applied to an extended apparatus in which a tray and a main function member can be moved to the storage status and the projection status for the electronic apparatus as indicated by, for example, Japanese Patent Laid-open Publication No. 2001-69391, Japanese Patent Laid-open Publication No. 2001-92564, Japanese Patent Laid-open Publication No. 2001-125662, and Japanese Patent Laid-open Publication No. 2001-125680. By the control of the function of the electronic apparatus having the extended apparatus described above, a tray and a main function material can be prevented from popping out of the electronic apparatus from the extended apparatus during the operation in the tablet mode or during the transfer with the power supply kept on, thereby eliminating of obstacle to the operation and carriage.

The control according to the present embodiment can be applied not only to a two-axis apparatus but to an electronic apparatus having first unit and second unit coupled by one axis. When the first unit and the second unit is in the closed status during the power-on and the electronic apparatus is carried around, the problems above can be prevented and the effect of the present functions can be maintained.

What is claimed is:

1. An electronic apparatus provided with a first unit having a keyboard and a second unit having a display screen, the second unit being coupled to the first unit through a coupling

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section having a first axis by which the second unit is opened and closed relative to the first unit and a second axis by which the second unit is rotated relative to the first unit, the electronic apparatus comprising:

5 a first sensor and a second sensor that are disposed on the first unit such that the first and second sensors are positioned closer to the coupling section than the keyboard and such that the first and second sensors are positioned along the first axis; and

10 a first member and a second member that are disposed on the second unit, the first member coming near and affecting the first sensor when the electronic apparatus is in a first closed status in which the second unit is closed to lie on the first unit with the display screen facing the first unit, and the second member coming near and affecting the second sensor when the electronic apparatus is in a second closed status in which the second unit is closed to lie on the first unit with the back of the display screen facing the first unit, the first member not coming near and not affecting the first sensor when the electronic apparatus is in the second closed status.

2. The electronic apparatus according to claim 1, wherein: the first sensor and the second sensor are both disposed on one side of the second axis; and

the first member and the second member are disposed such that the second axis is interposed therebetween.

3. The electronic apparatus according to claim 1, wherein: the first sensor and the second sensor are both disposed closer to a surface on which the keyboard is placed in the thickness of the first unit;

the first member is disposed closer to a surface on which the display screen is placed in the thickness of the second unit; and

the second member is disposed closer to the reverse of the surface on which the display screen is placed in the thickness of the second unit.

4. The electronic apparatus according to claim 1, wherein the first sensor and the second sensor are disposed on the same circuit substrate.

5. The electronic apparatus according to claim 1, wherein the first sensor and the second sensor are magnetic sensors, and the first member and the second member are magnets.

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